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POWER

FRED R. LOW, *Editor*

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Making Public Opinion

I FORGET who it was who said, "Let me write the ballads of a nation and I care not who writes its laws," or words to that effect.

A modern sage might say, "Let me write the newspapers of a nation and I care not who owns the Legislature and the judiciary."

An informed and properly animated electorate will stand for only so much inefficiency, to say nothing of departure from rectitude and justice.

But a people whose minds are attuned to the daily influence of their principal source of information, interpretation and inspiration may be molded to any opinion not absolutely idiotic, influenced into action that time will prove unwise or lulled into impercipient inactivity when the leaders want to keep the boat from being rocked.

This is not so true as it was some years ago. The devoted reader with an abounding faith in the disinterested consecration of his favorite paper to his service is becoming less numerous, less credulous and naïve.

Other methods more in accord with the express rate at which we live are offering for forming those individual conceptions of life and affairs that aggregate into public opinion.

Is deliberative, assimilative reading getting to be too slow—like buggy riding?

What will be the composite of a public mentality fashioned by the tabloid, the movie and the radio?

And who will pull the wires of the wireless?

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

POWER was founded in November, 1884, by E. P. Harris and H. M. Swetland. With it was incorporated "Steam," which had been started by N. Hawkins in Chicago two years earlier.

Ownership later passed to H. M. Swetland and James H. McGraw; then to John A. Hill; and with the consolidation of the Hill and the McGraw Publishing Companies in 1917, it became the property of the McGraw-Hill Publishing Company.

Robert Grimshaw was the first editor of "Power." Subsequent editors for short periods were George L. Fowler, A. D. Risteen and Franklin VanWinkle. F. R. Low became editor in 1888.

The present staff is F. R. Low, editor; A. D. Blake, managing editor; G. L. Montgomery, P. W. Swain, F. A. Annett and L. H. Morrison, associate editors; Thomas Wilson, Western editor; and A. L. Cole, R. B. Purdy, H. R. Clark and L. E. Driscoll, assistant editors.

Why Cost Systems?

IN THESE somewhat enlightened times it is unusual to find an even halfway successful manufacturer who does not have a good cost system in his factory. Most now realize how important this is to their business. It would not be possible for them to engage in successful competition in an open market unless they knew all the details of their costs. Prices may not be based on production cost, but this figure must be known if business is to be conducted on a safe margin.

Just step through the door from the factory into the power plant, and the scene changes. Very many manufacturers do not see the value of detailed cost records in this department. If they know the total cost of labor, supplies, fixed charges and other items of expense, they know the total cost of their power and this can be distributed equally among the finished products.

There are two reasons, however, why this beautifully simple procedure is dangerous. It lumps all the power costs in one and allows no determination of the part chargeable to each department and manufacturing operation. This makes strict cost control impossible, for variations in unit power service use are one of the few readily available measures of manufacturing efficiency. Thus power costing, accomplished by the use of meters on all department and important single operations, and periodic tests on all other power service uses, are necessary to proper factory operation.

It is also necessary to have full cost records in order to control operation of the power plant. Unless the details of the operating cost of each piece of equipment are known, it is difficult and often impossible to correct conditions that are causing unwarranted expense.

The ultimate goal of the power engineer's work is to keep the cost of power services, as represented in the finished products of the factory, at the lowest point. This can be done only through the use of an adequate cost system. The wise engineer will see that the management realizes this and acts accordingly.

Steam—Nature's Thermostat

WHEN man invents thermostats for the control of temperature, he sometimes forgets the even more ingenious devices by which nature accomplishes the same result.

So closely does the normal human body maintain its internal temperature of 98.6 degrees Fahrenheit that a variation of two or three degrees is a signal to call the doctor. Incidentally, nature here uses the cooling-tower principle with a flow and evaporation of perspiration just sufficient to maintain a balance between heat given off in the body and heat carried away.

Much simpler, but equally wonderful because it is so simple, is the inherent thermostatic quality of saturated steam.

The fact that saturated steam at constant pressure will lose heat, but won't "cool off" is rather interesting when one stops to think about it. As radiation and convection from the surface of the containing pipe or drum removes heat, certain of the particles of steam meet the demand by turning into liquid water and giving up their latent heat. As long as any vapor is left uncondensed, its temperature will be that given by the steam tables for the corresponding pressure.

The fact that the temperature of saturated steam is not affected by loss of heat, and that it cannot be raised by bottling up the heat, gives steam great significance as a heating medium in industrial processes where close temperature regulation must be maintained. In this respect it has an advantage even over electricity, for the maintenance of constant temperature with electric heat requires direct regulation of the energy input to correspond with the fluctuations in the heat radiated from the process container.

A completely steam-jacketed oven will maintain constant temperature regardless of the thickness of outside insulation, or the condition of the surrounding space as to temperature and drafts. That the opposite must be true of electric heat may quickly be demonstrated by wrapping thick cloth around an electric light bulb; in a few minutes the cloth will be smoking. It may even be set on fire. Blankets may be piled on a steam radiator with no rise whatever in the temperature of the steam and only a slight rise in the temperature of the outer metal.

In one case we have a constant-energy-input source of heat with fluctuating temperature; in the other a constant-temperature source with energy input fluctuating as necessary to maintain constant temperature.

This thermostatic property of steam is widely applied today in industry, often without a full understanding of its significance. It is capable of even broader application, particularly in those chemical industries where reactions must take place between narrow temperature limits.

Beyond the limits of practical saturated steam temperatures other saturated vapors, such as those of mercury and diphenol, permit an extension of the same principle.

Twenty-Five Cycles Burden on Industry

REASONS that once may have existed for alternating-current systems of different frequencies have long since disappeared. The only justification for more than one frequency at the present time is that the others cannot be easily eliminated. With the exception of one power system, twenty-five and sixty cycles have become the practical standards in this country. Both have been adopted so extensively as to make the change from one to the other a difficult and expensive undertaking.

Twenty-five cycles came in use to meet application needs where, at that time, sixty-cycle current was not well suited. In the central-station industry the early twenty-five cycle rotary converters were much more satisfactory than sixty-cycle machines. On the other hand twenty-five-cycle current was not suitable for lighting. Modern sixty-cycle rotaries are just as satisfactory as twenty-five-cycle machines; therefore, one of the chief reasons for the twenty-five-cycle system has disappeared.

In the steel industry, the other large user of twenty-five-cycle current, this frequency was adopted chiefly because slow-speed twenty-five-cycle motors have superior characteristics compared with those of sixty-cycle machines of the same speed. Improvements made in reduction gears, the increased use of both synchronous and direct-current motors and other changes in electrical practice have eliminated the reasons for adopting the twenty-five-cycle system in steel mills.

If the twenty-five-cycle system were eliminated, it would greatly simplify many of the problems in the electrification of industry. A twenty-five and a sixty-cycle system cannot be connected together except by expensive and complicated rotating machinery. As the power systems of the country become more interconnected and these with large industrial plants, this problem will become more accentuated.

Twenty-five-cycle equipment is, in general, more expensive than sixty-cycle. In the case of transformers, the increased cost may be as high as fifty per cent. In generating equipment the tendency is toward higher-speed machines. Where twenty-five cycles are used, the maximum speed is limited to fifteen hundred revolutions per minute, where on a sixty-cycle system it is thirty-six hundred. In the small- and medium-size machines this difference in maximum speed may cause a large divergence in their cost.

To change from twenty-five to sixty cycles will generally be expensive. To extend the use of the lower frequency is also costly. Whichever way it may be considered it is a burden on industry. In the long run a change to sixty cycles will prove the most economical, and in any future extension to power systems this problem should receive careful thought.

Steam Pressures in Industrial Power Plants

WHAT steam pressure shall be used when a new industrial power plant is being planned? This question often confronts both the designers and operators of the new plant. The answer is not a simple one, for the factors to be considered have been multiplied of late years. Frequently, there are such limiting conditions as a total cost that must not be exceeded or plant process requirements that must be satisfied. These limitations place certain restrictions on freedom of design.

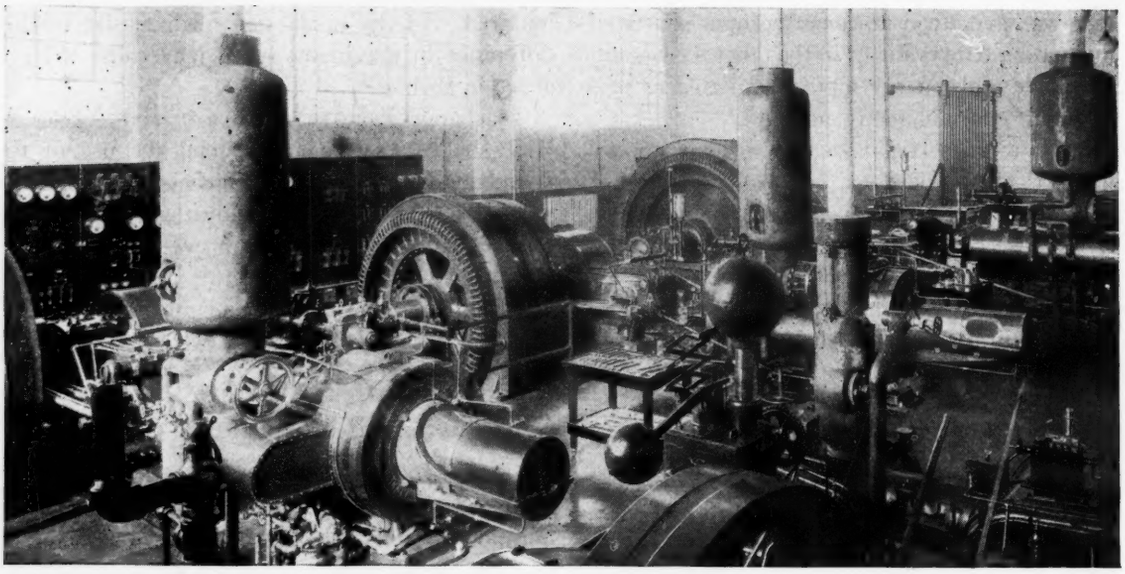
In the first place, many industrial power plants are isolated; that is, they have no interconnection with central stations and must depend solely upon their own resources to supply adequate service. The amount of reserve equipment depends on the nature of the industry, the seriousness of shutdown, and the amount of money the owners are ready to spend to provide for continuity of service.

When process requirements call for much steam at both moderate and low pressures and where fuel costs are high, then high boiler pressures should be given full consideration. Some economical power plants can be planned when power is generated by the heat energy from boiler to service pressures at a heat rate of around forty-five hundred B.t.u. per kilowatt-hour. Where there are no process steam requirements, it is a problem whether power can be generated more cheaply than a public utility can furnish it.

High coal costs warrant larger plant expenditures to secure economy and hence higher boiler pressures. Low fuel costs permit the use of a simple inexpensive plant of lower pressures. Waste-heat boilers may require low pressures to permit full utilization of the available heat.

The cost of boilers rises rapidly with increasing pressure. Most industrial boilers have too small furnaces and operate at too low ratings. Very high ratings require water-cooled furnaces. There is also the question of air preheaters or economizers. Superheat temperatures are generally too low in industrial plants.

The selection of the steam pressure for the industrial plant is thus a confusing problem with many factors to be considered. It is worthy of the best thought and skill of engineers before a final decision should be made. Meanwhile, it is significant that many plants in the process industries are employing around four hundred pounds.



The engine room, containing three uniflow units

Installation of Engines
Cuts Down Coal Bill

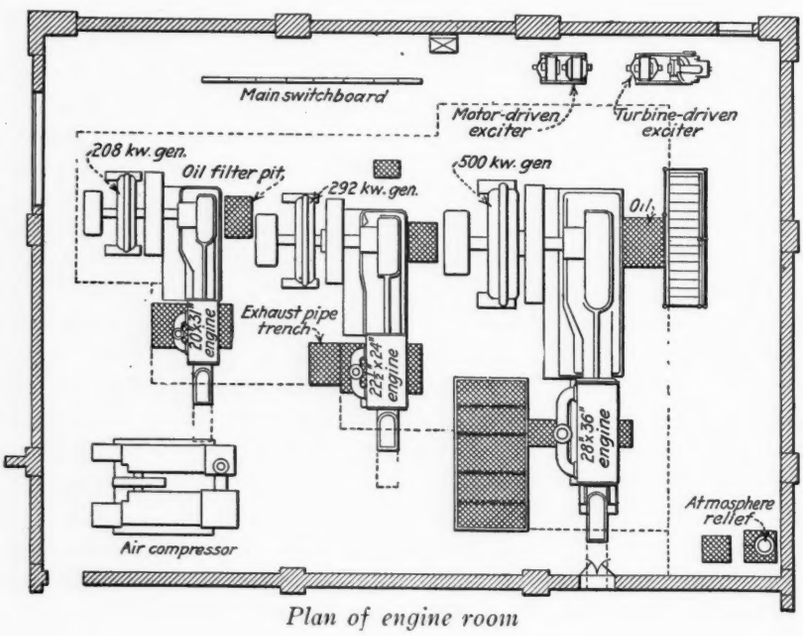
By C. T. Snow

Montgomery Ward & Company save over $2,500 per month in operating expenses for first quarter of 1929 when uniflow engines replace purchased power at St. Paul plant. This saving is available to pay for the generating equipment.

The St. Paul plant of Montgomery Ward & Company was constructed in 1920. The original project consisted of a three-story administration building and a nine-story merchandise building. In 1926 an addition was made to the latter building, making a total of 1,233,363 sq.ft. of floor space requiring 754,933 sq.ft. of steam radiation. The buildings were served by a power house containing three 3,500-sq.ft. water-tube boilers, two of which were equipped with multiple-retort underfeed stokers. Provision was made for the installation of engines and generators at a later date, but it was not deemed expedient to make the additional investment required for the installation of a complete power plant at that time.

Arrangements were made to purchase electrical energy from the local power company, and the boilers were used for heating and for the operation of certain auxiliaries. It was necessary, however, to run at least one boiler even during the non-heating season to operate the steam-driven air compressor and supply steam for domestic purposes.

It became apparent to the owners, however, that a considerable saving could be made by installing their own generating apparatus and using the exhaust steam from the engines to heat the buildings. For this reason a contract was entered into with the Commonwealth Electric Company, contracting engineers, of St. Paul, in July, 1928, for the installation of three Skinner universal uniflow engines to be direct connected to General Electric generators, together with the necessary foundations, piping, electric wiring and switchboards.



Plan of engine room

The average daily maximum demand was approxi-

mately 640 kw. In order to provide proper flexibility it was decided to install one 500-kw., one 300-kw. and one 200-kw. unit, the generators rated at 40 deg. C. full load continuously and 25 per cent overload for two hours at 50 deg. C.

There being a basement below the engine room, it was necessary to build a foundation extending from below the basement floor up to the engine-room floor.

The steam supply for the engines is brought in overhead from a 14-in. header in the boiler room, through long-sweep pipe bends terminating in receiver-type steam separators located immediately above the throttle valves. The exhaust pipes are carried below the floor through a larger receiver-type oil separator and connect to the 16-in. low-pressure heating main, which is provided with a 14-in. atmospheric relief line.

It was imperative that all alterations to the existing plant be carried out without interruption of service except for a few hours at night or on Sundays. This was necessary because practically all orders received by Montgomery Ward & Company are shipped the same day they are received, a rigid adherence to predetermined schedules thus being required.

The installation of the new generating equipment was completed in January, 1929, and the results of the first three months' operation have been very gratifying, as will be noted in the following comparison of February, March and April, 1929, with the corresponding months of 1928:

FEBRUARY

	1928	1929	Saving in 1929
Electric light and power purchased	$2,445.05		
Fuel consumed (1928) 861.7 tons	5,086.90		
Fuel consumed (1929) 824.2 tons	.....	$4,853.62	
Total direct operating expense	1,372.97	1,326.99	
Total	$8,904.92	$6,180.61	$2,724.31
Publicity acct. (floodlighting-chargeable to advertising)			18.00
Total gross saving for February, 1929			$2,742.31
K.W. Hr. consumption (Correct data not available)			
Meteorological Data			
Mean maximum daily temperature	27.7 deg. F.	17.2 deg. F.	
Mean minimum daily temperature	14.0 deg. F.	2.1 deg. F.	
Mean temperature	20.8 deg. F.	9.6 deg. F.	
Mean wind velocity, miles per hour	11.4	8.5	
Prevailing wind direction	N. W.	N. E.	

MARCH

	1928	1929	Saving in 1929
Electric light and power purchased	$2,130.98		
Fuel consumed (1928) 801.72 tons	4,730.23		
Fuel consumed (1929) 723.62 tons	.....	$4,269.42	
Total direct operating expense	1,634.86	1,650.57	
Total	$8,496.07	$5,919.99	$2,576.08
Publicity acct. (floodlighting, chargeable to advertising)			18.00
Total gross saving for March, 1929			$2,594.08
Kilowatt-hour consumption	114,800	155,800	
Meteorological Data			
Mean maximum daily temperature	41.6 deg. F.	41.2 deg. F.	
Mean minimum daily temperature	23.7 deg. F.	25.2 deg. F.	
Mean temperature	32.6 deg. F.	33.2 deg. F.	
Mean wind velocity, miles per hour	10.5	11.0	
Prevailing wind direction	N. W.	N. W.	

APRIL

	1928	1929	Saving in 1929
Electric light and power purchased	$2,168.89		
Fuel consumed (1928) 606.85 tons	3,580.07		
Fuel consumed (1929) 565.33 tons	.....	$3,097.54	
Total direct operating expense	1,060.78	1,203.15	
Total	$6,809.74	$4,300.69	$2,509.05
Publicity acct. (floodlighting, chargeable to advertising)			18.00
Total gross saving for April, 1929			$2,527.05
Kilowatt-hour consumption	107,600	138,400	
Meteorological Data			
Mean maximum daily temperature	47.6 deg. F.	55.6 deg. F.	
Mean minimum daily temperature	35.3 deg. F.	37.2 deg. F.	
Mean temperature	41.4 deg. F.	46.4 deg. F.	
Mean wind velocity, miles per hour	13.5	11.2	
Prevailing wind direction	N. W.	S. E.	

An interesting feature of this comparison is that although the mean temperature for February, 1929, was 11.2 deg. lower than for February, 1928, 37.5 fewer tons of coal were burned in February, 1929, to generate the electrical energy and heat the buildings than in February, 1928, to heat the buildings only.

During March, 1929, there was a saving of 78.1 tons of coal over March, 1928, although the outdoor temperature was practically the same. In like manner April, 1929, shows a saving of 41.5 tons.

It will be noted, however, that during March, 1929, there was an increase of 41,000 kw.-hr. in the electrical load, and in April, 1929, an increase of 30,800-kw.-hr. If the electrical load in 1928 had been as great as in 1929, the gross savings for March, 1929, would have been approximately $800 greater, and for April, 1929, approximately $600 greater.

The writer is indebted to C. E. Laurette, chief engineer of the St. Paul plant of Montgomery Ward & Company, for much of the data presented here.

Making High-Voltage Equipment Safe to Work Around

By Marin Phillips

IF HIGH-VOLTAGE equipment is to be installed near a group of machines, it should be isolated. This is best accomplished by installing it in a room especially built for the purpose. When such a room is provided rules should be enforced as to who may enter it. In some cases it will be advantageous to keep the room locked and in others unsafe. No switch or transformer room should be locked that will prevent access to the main switch for shutting off the power in an emergency.

Sometimes it will be impossible to provide separate rooms for the isolation of all the high-voltage equipment. In such cases it must be protected by fireproof enclosures to guard against a person or object accidentally coming in contact with live parts. Ample provision must be made for workmen while cleaning and repairing or making adjustments. Such enclosures are a great aid in preventing accidents and short circuits when tools, pipes and other material are being handled.

Where enclosures cannot be used conveniently, some form of safety guard must be placed around the equipment. Under some conditions a pipe railing can be installed. To provide complete protection to equipment and workers it will be necessary to build a framework of pipe or angle iron and cover the frame. A filler covering can be made of wood strips, sheet metal, perforated metal, expanded metal or wire mesh. Expanded metal probably makes the best filler covering for the framework and can be obtained with almost any sized openings. The size of openings in the metal will depend on the size of the material handled near the enclosure. If nothing is moved near the equipment but large objects, the size of the openings can be larger than if small rods and pipes are handled.

In guarding electrical equipment, wood, while it is a non-conductor when dry, should be avoided. Wooden guards will cost less to install, but frequently need repairs. Metal guards can be built strong enough to stand a lot of abuse, they last much longer and are not inflammable. When metal guards and fences are placed around electrical equipment, they should be well grounded whenever there is possibility of their being made alive by an accident such as a broken insulator or wire.

BETTER LIGHTING
For the Power Plant

By A. D. Bell
Edison Lamp Works of General Electric Company
Harrison, N. J.

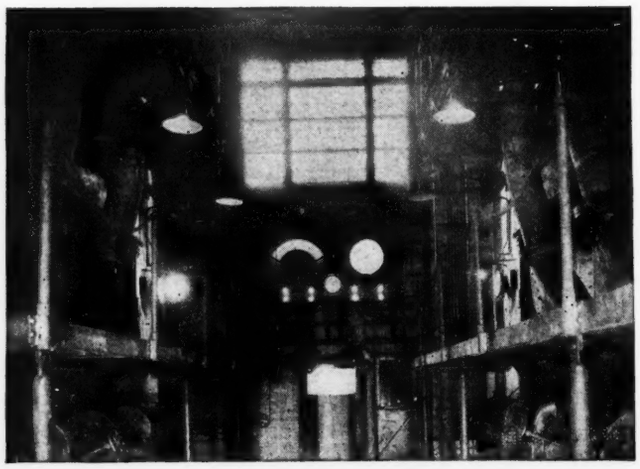
ADEQUATE lighting is an outstanding factor in assuring efficient and safe performance of industrial operations. In modern power houses the lighting in general is fair—in fact, much superior to that found a few years ago. However, in view of the important position that the central station industry occupies today, the lighting should be the best. The boiler room and engine room especially demand particular consideration from the viewpoint of the illumination.

The Boiler Room

The boiler room is not the dingy, dirty place that it once was, since the use of modern stoking and ash-removal machinery. However, from its very nature, it often is not considered as requiring more than ordinary illumination. This is a mistake, for the entire operation of the power plant depends on an uninterrupted and sufficient flow of steam.

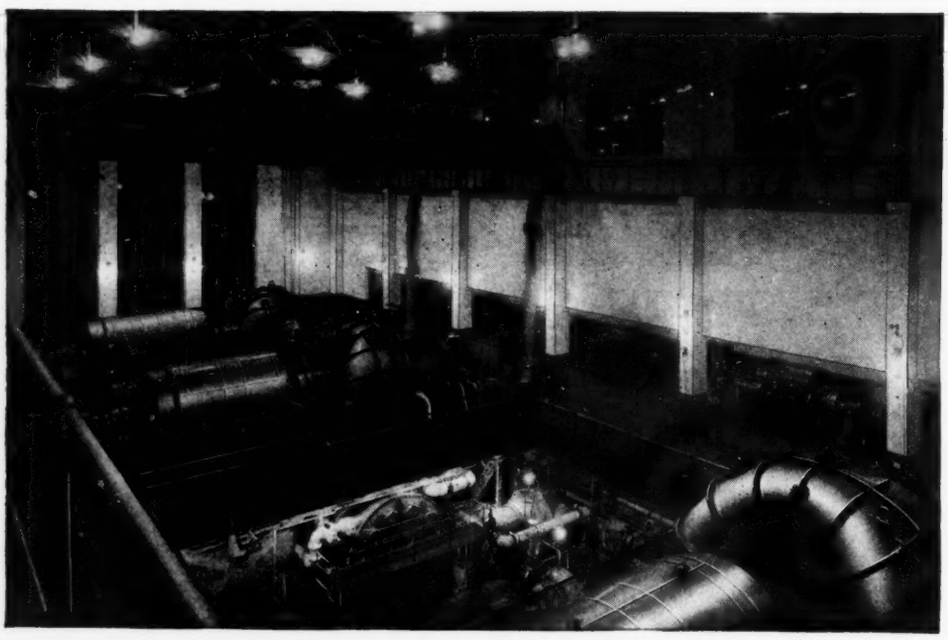
Illumination of the gages is most important. They require a local illumination and should be easily read from a considerable distance. The old method was simply to suspend a 15- or 25-watt lamp on a drop cord in front of the gages. This is unsatisfactory, for as much light struck the eyes of the individual trying to read the gage as reached the gage itself.

By using a small half-shade, with the shade so placed as to keep the light out of the eyes of the observer, a fairly good arrangement may be secured, with the exception that reflection of light from the glass dial will often prevent a reading from certain positions. A dial of translucent material, having a lamp of low wattage back of it, is also a good arrangement.



Illumination in a boiler room by means of enameled-steel dome reflectors and high-wattage lamps. The general level of illumination is very fair. Note the glare at some of the gages resulting from the use of bare lamps

For water gages a device that works very well consists of a dustproof box made of brass and enameled white on the inside. Within the box is a 40-watt lamp. The edge of the box next to the gage is slotted and covered with a strip of frosted red glass. Water within the glass column has the effect of magnifying the red strip of light



Illumination in a generator room provided by prismatic glass reflectors hung in pairs

so that it appears to fill the tube, while the space about the water produces the apparent reverse and the red is seen as a fine line. The water level can then be quickly determined by the appearance of the red line.

For the boiler room itself a good intensity of general illumination is desirable. The R.L.M. standard dome reflector, usually with 100- or 150-watt lamp, is recommended. The units should be hung from ten to fifteen feet from the floor and spaced from ten to fifteen feet apart. Frequent cleaning of the lighting equipment here is necessary on account of excessive dust accumulations.

The Engine Room

The engine or turbine room is one of the most interesting and attractive places in the plant. In fact, it is the chief "show place" of the plant, and in order to present a pleasing appearance it frequently is spacious, with light-colored walls and ceilings. In keeping with the character of a place of this kind it is desirable that the artificial illumination be of a high quality and of a sufficient intensity. In view of nation-wide interest being taken in lighting and the power industry on account of the observance of "Light's Golden Jubilee," it is especially fitting that the generator room be well illuminated. Not only will proper illumination enhance the general appearance of the place, but, what is more important, it will allow repairs and adjustments to be made at any time.

Several types of lighting equipment have been used with more or less good results in the engine room. A direct-lighting reflector is necessary, as the working level is, of course, comparatively near the floor. One reflector that is well suited when the ceilings are high, is the Holophane high bay reflector No. 691-AL. This is made of prismatic glass, which directs the majority of the light downward, although a certain amount is transmitted upward and to the side walls. Because of its fairly high mounting, it is possible to employ rather wide spacing of the Holophane lighting unit and still obtain an even intensity. This will permit the use of lamps in the 750-, 1,000- and 1,500-watt range. An intensity in the neighborhood of ten foot-candles is according to modern lighting practice. With a spacing of lighting units of 25x40 ft., a 1,500-watt lamp would be satisfactory.

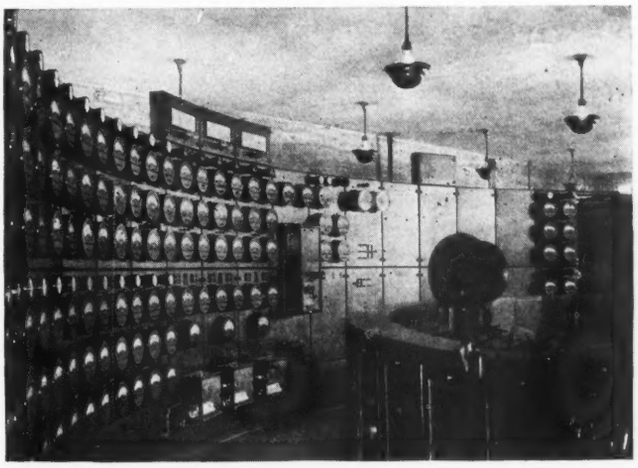
In case the ceiling is lower and the possible spacing of the lighting units is not so great, an inclosing globe of opalescent or prismatic glass may be used. To obtain proper diffusion it is recommended that 300-, 500- or 750-watt lamps be employed. Larger wattages would, in most instances, tend to be glaring.

Whatever the height and the spacing of the lighting units may be, provision should be made so that they can readily be cleaned and maintained. It is customary to have a traveling electric crane for moving machinery, and a convenient method whereby the units can be taken care of is to have them within reach of the crane.

Another point that should receive careful consideration is the lighting of the control board. When the necessity arises, as is often the case in emergencies, the operator should be able to read the instruments at a glance and should not be hampered by trying to accustom his eyes to direct or reflected glare.

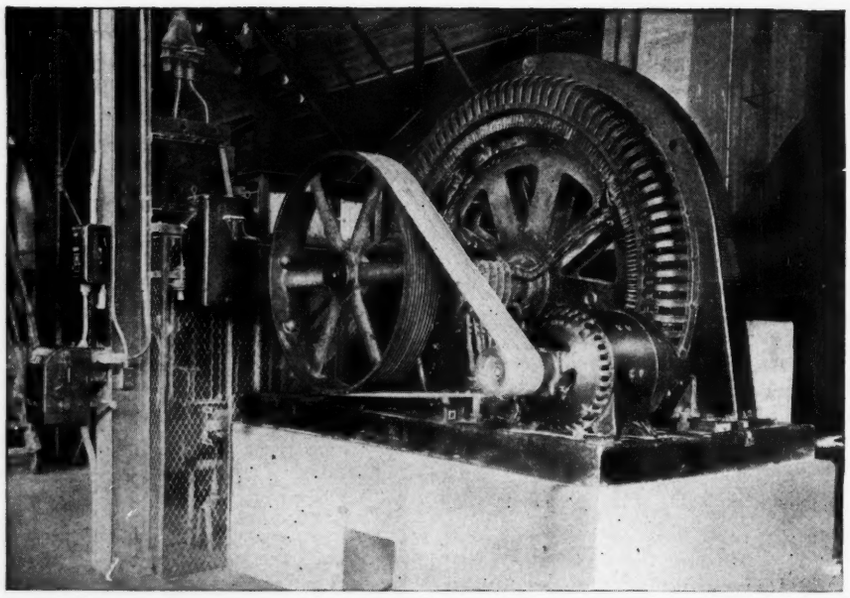
Switchboard lighting has been almost altogether confined to two forms. In the earlier of these a comparatively low-wattage lamp was suspended by a gooseneck bracket from the top part of the board; a later improvement was the addition of small lamps behind the dials of the instruments. Objection may be cited against both of these methods; in the former a large amount of reflected glare is present, preventing the indicators from being read from certain angles; in the latter method the position of the source of light is much better, but low intensity prevents reading of the dials at any distance.

Almost simultaneously with the introduction of the remote-control type of board, semi-indirect and totally indirect lighting were first employed. With either of these methods the illumination of the front of the board is uniform and, provided sufficiently high wattage lamps are installed, ample light is available, instrument readings being possible quite far from the board. In central stations where the switchboard design is such that the instruments are simply placed on panels and actual operation is obtained from a control desk several feet from the meters, the semi-indirect and totally indirect installations are recommended. With properly designed lighting systems of the latter types no reflected glare is obtained from the glass covers of the instrument dials.



A control board lighted by totally indirect illumination

Water Fed to Steel Tube Economizers should be slightly alkaline and contain not over 0.3 c.c. oxygen per liter, preferably not over 0.2. These are conditions that can readily be maintained with only ordinary attention on the part of operators, but in many plants adequately equipped for the maintenance of satisfactory conditions as to oxygen content of feed water, the making of oxygen determinations is not one of the routine duties assigned to operators, with the result that an unsatisfactory and harmful amount of oxygen is present in the feed water. It is generally supposed that the making of oxygen determinations is a difficult and complicated procedure. This is not the case. Oxygen determinations can be made at regular intervals by regular operating personnel, and each determination represents about one minute of operator's time. Putting oxygen measurement into the hands of the operating personnel has the added advantage that through it the operators acquire first-hand experience in the control of the conditions which determine the amount of oxygen in feed water. If the operating force are given apparatus of this type to measure oxygen and told to keep it down to a certain standard, the desired results will be easily obtained.—*W. F. Keenan, Jr., before the Association of Iron and Steel Electrical Engineers.*



Hytork synchronous motor rated at 150 hp., 440 volts and 144 r.p.m., with Texrope driven exciter.

SYNCHRONOUS MOTORS

Increase in Size and Applications

By Fraser Jeffrey

Engineer, Electrical Department,
Allis-Chalmers Manufacturing Company

A Directly Connected Synchronous *motor that will start under heavy load at high power factor without serious disturbance to the power generating and distributing equipment and when up to speed will operate at unity power factor*

THERE are power loads requiring a large static and accelerating torque and also a high pull-in torque. This applies to certain lineshaft drives, as in flour mills, grinding and crushing machinery such as coal pulverizers in power plants, and tube mills in the cement and mining industries. For such drives a starting torque of from 100 to 150 per cent of normal, with 100 per cent accelerating and 100 per cent or more pull-in torques, are required.

For example, in the cement industry it was customary to drive tube mills by slow-speed slip-ring induction motors, the speeds in most cases being 180 r.p.m., which on a 60-cycle circuit requires the use of a 40-pole motor. These slow-speed motors had an inherently low power factor, on the order of approximately 65 to 70 per cent at full load. When a large number of these motors were used in a single mill, the wattless current imposed on the power system became so great that means for correcting the power factor became necessary in order that more of the true energy capacity of the plant's generating or power-supply equipment could be utilized. The sizes of the mills and the motors have been increasing gradually from 300 and 400 hp. to 700, 800, 900 and even as high as 1,500 hp., so that the question of power factor became a real problem, not only on the distribution system but also in the power stations.

It is highly desirable to start motors under heavy load and high power factor, with a minimum line and power-generating equipment disturbance. When the load is up to speed it is also desirable to operate the motor at unity power factor. Because there is a desire to avoid the use of clutch or slip mechanisms that will first allow the motor to come up to speed without load, what is known as the Hytork synchronous motor was developed. This type of motor is coupled directly to its load without any interposed unloading device and automatically accomplishes the starting of heavy loads with minimum line disturbance. Once it is up to speed, it operates at unity power factor.

In reality this motor is a wound-rotor type induction motor, with certain modifications, that acts as a synchronous motor when supplied with direct-current excitation. The stator is similar to that of a regular induction

motor with the exception that the coils are specially wound to suit the peculiar conditions inherent in this type of motor. The rotor is made with either open slots or semi-closed slots, depending on the capacity and speed of the motor. When open slots are used, the rotor resembles a direct-current armature without a commutator (Fig. 3); when semi-closed slots are used, the rotor resembles that for a regular slip-ring type induction motor. These rotors, as will be seen in Fig. 3, have a fully distributed winding, with leads brought out to five instead of the usual three slip rings on the wound-rotor motor. Three of these rings are connected to the secondary-resistance starter, and the extra two slip rings are connected to the exciter.

An exciter of the low-voltage type is permanently connected to the rotor windings at all times and may be driven by a Texrope drive from the main motor shaft. This arrangement, as the headpiece shows, allows the use of short centers and the placing of the exciter directly on the base of the main motor. For large units separate motor-generator exciter sets, Fig. 1, may be used.

The ordinary type of primary control, such as switches, interlocks, etc., can be used. In addition a rheostat in the field of the exciter and a regular induction-motor secondary starter, either automatic or manual, interlocked with the primary oil switch is required. The automatic type of starter is best suited to the larger-capacity units.

With all secondary resistance in circuit, the exciter being permanently connected in the rotor circuit, the primary oil switch is closed and the motor accelerates like a regular slip-ring type induction motor as the secondary resistance is gradually cut out of the circuit. In the meantime, the exciter is gradually building up its field, so that when the secondary resistance is all out the motor automatically pulls into step and operates as a synchronous motor.

When automatic secondary control is used all that is necessary is to close the line swtich. There is no complication in switching the exciter in and out of the circuit or juggling of the field excitation. Owing to the unusually high pull-in torque of this type of motor and the fact that the exciter is permanently connected in the rotor circuit, starting is simplified to the extent of closing the main-line switch, the operation being analogous to that of the simple slip-ring induction motor.

A Hytork sychronous motor rated at 1,500 hp., 2,200 volts, 3-phase, 60 cycles and 163½ r.p.m. has been in operation for some time and gives an idea of the size and applications possible.

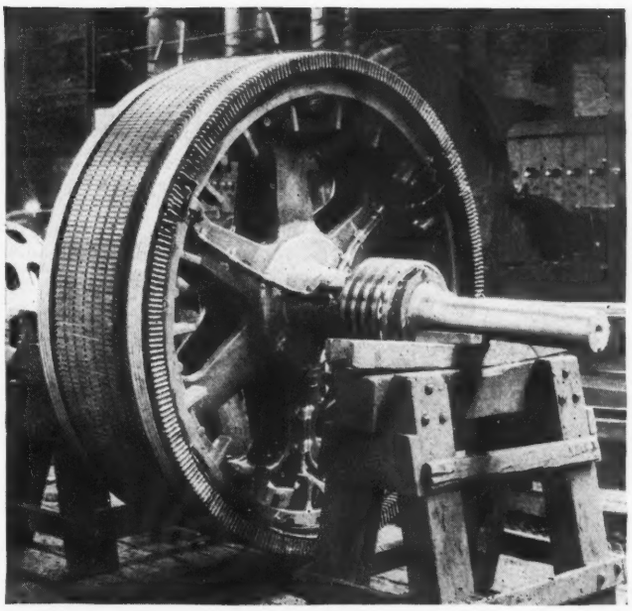


Fig. 3 (Above) —Rotor of 150-hp. synchronous motor with open-type slots. The leads from the windings are brought out to five slip rings. Three of these rings connect to resistance starter, and two are connected to the exciter.

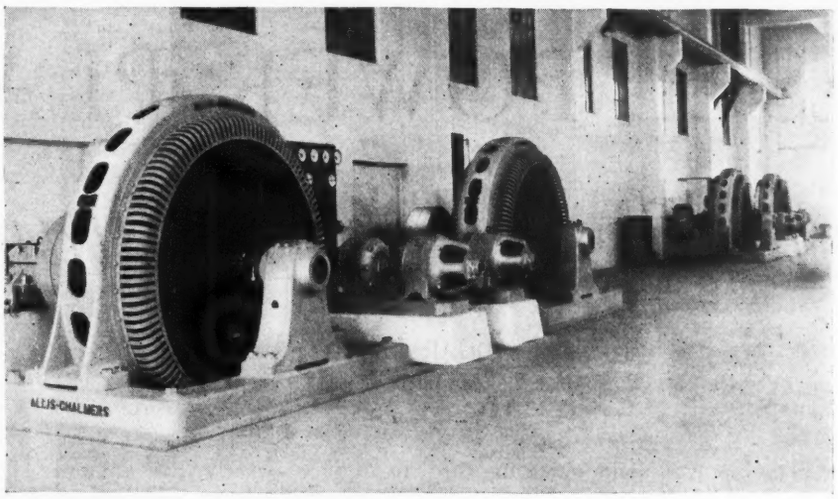
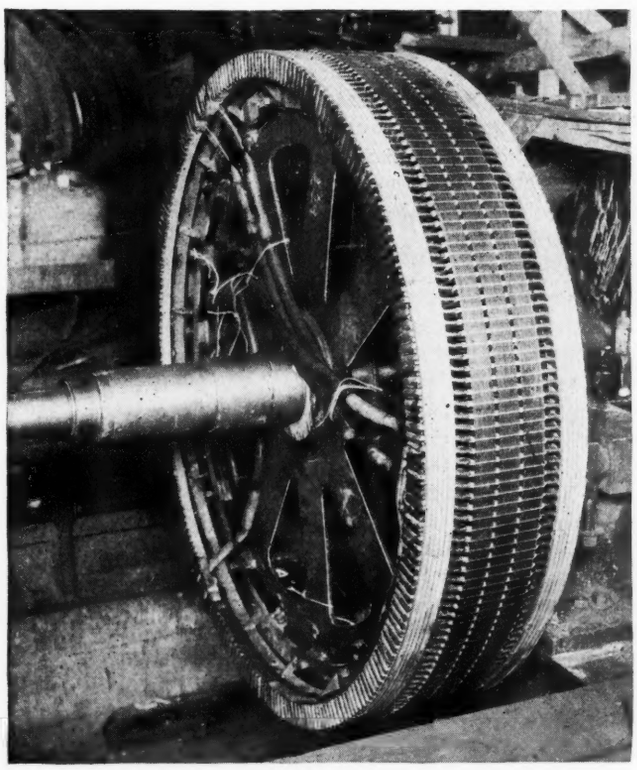
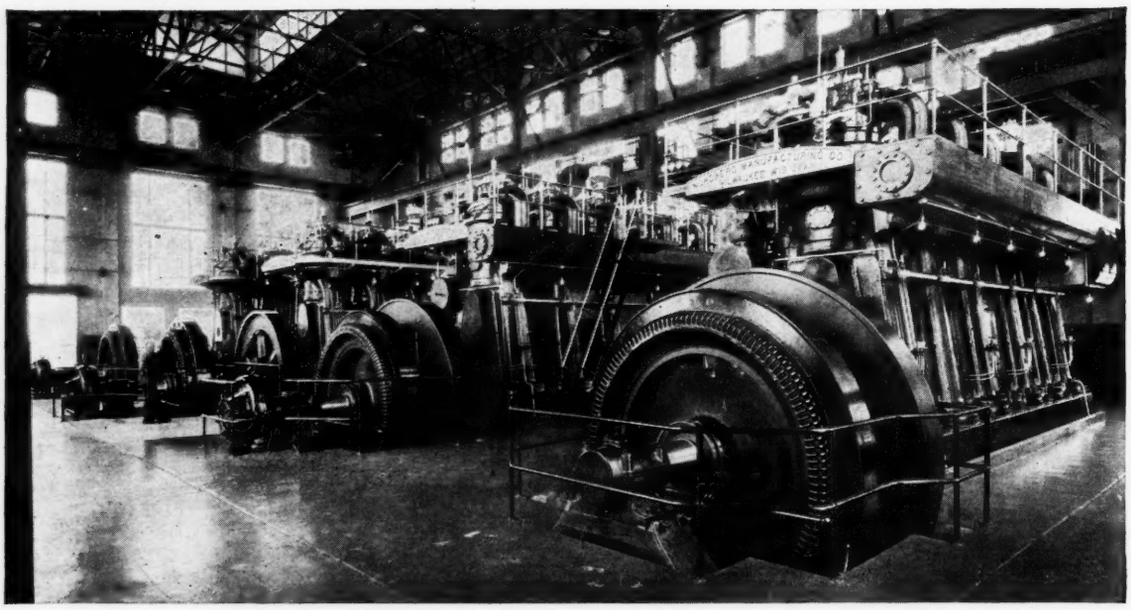


Fig. 1 — Four 800-hp., 100 per cent power factor, 2,200-volt three-phase 60-cycle 180-r.p.m. Hytork synchronous motors. Each motor has its own motor-driven exciter. Fig. 2 (Below) —Rotor of 900-hp. synchronous motor with semi-closed slots





Ponca City, Oklahoma, Diesel Plant

DIESEL POWER PLANTS

Should Be Carefully Planned

By Edgar J. Kates
Consulting Engineer, New York

IN DESIGNING a Diesel power plant choosing the right engine is not enough; the engine is only a part of the complete plant, and equal care should be given to the layout of all that goes to make such a plant adapted to the particular purpose for which it will be used. In many kinds of Diesel installations thorough attention to the plant layout will result in improved performance, evidenced not so much by better thermal efficiency as by greater reliability and decreased operating cost.

When comparing gas or oil engines with steam power, it is often remarked that the internal-combustion engine is a power plant in itself. That is true from the viewpoint that no boiler is needed to convert the fuel's potential chemical energy into heat. It is not true, however, when we have in mind the auxiliary services that must be supplied to the gas or oil engine. Just as many an airplane flight has ended prematurely because of "plumbing trouble," such as a break in a fuel or lubricating oil line, so the modern Diesel's steady performance depends upon serving it unfailingly with lubricating oil, cooling water and fuel. Let one of these cease and the engine must perforce stop, though it be in perfect working order. The designer of the engine has little control over these services; they must be provided for in the planning of the power plant as a whole, and their importance emphasizes the need of thoughtful attention to the layout of each new plant.

In several plants where care has been taken in providing reliable auxiliary services, it has been found possible to reduce greatly the amount of supervision usually thought necessary. The reason is clear if one analyzes the duties of an attendant in the ordinary Diesel power plant. They are mostly routine matters connected with the supply of lubricating oil, cooling water and fuel, and if these services are made really safe by good plant design, the attendant's duties are reduced to starting and stopping and to an occasional inspection, all of which consume but a fraction of the time ordinarily required. Good plant design can make these services far more dependable than a crude layout that depends upon continuous supervision. The engine is benefited by the constancy with which it is served, and responds with uniformly reliable performance and minimum cost of repairs. These benefits, together with the reduced payroll expense, will justify the cost of looking after these services properly when the plant is being designed.

The pressure-feed lubricating systems with which most modern Diesels are equipped make it easy to maintain reliable lubrication with little supervision. By using a duplicate pumping system, the possibility of a failure in the supply of lubricating oil is reduced to a minimum. However, to guard against even this small contingency and against the possibility of a break in the piping, a simple alarm may be installed to warn when the oil pressure has become too low. It is quite feasible also to arrange a signal to warn when the temperature of the main bearings rises too high, but this extreme precaution is seldom necessary. If there is any possibility that the

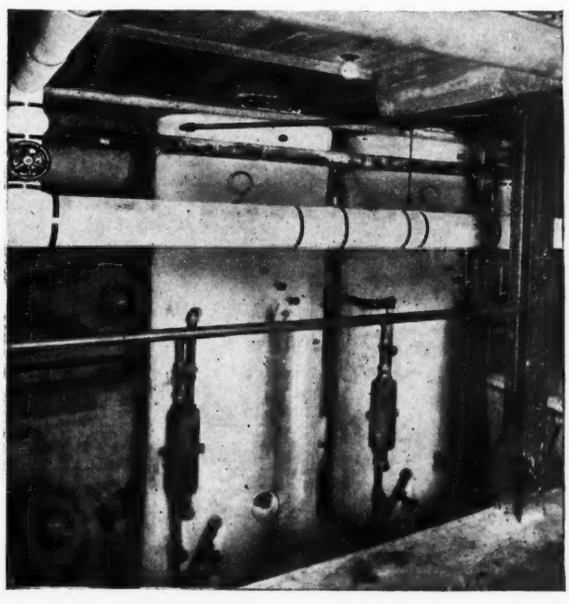
alarm for low oil pressure should go unheeded, an interlocking arrangement can be connected to the engine fuel pump so as to shut off the fuel if the lubricating oil pressure is allowed to drop too far. There are several makes of engines that have already been provided with devices of this sort. Clogging of the oil lines can be prevented by keeping the lubricating oil clean with a centrifuge or a reclaimer.

The simplest way of assuring the reliability of the jacket-water supply is to feed the engine by gravity from an overhead tank which is always kept full and overflowing by the circulating pump. The overhead tank has several advantages. It affords a reserve supply of water in case of any derangement, and it is a convenient place to connect an alarm and float valve which will go into action as soon as the water supply fails and the level in the tank starts to drop. Thus the engine can never go dry, since the emergency supply fed into the overhead tank through the float valve will keep it supplied until the attendant, whose attention has meanwhile been called by the low-level alarm, rectifies the trouble with the pump. In plants where an overhead tank is not used, an interlock can be arranged, similar to that for the lubricating oil, which would shut down the fuel pumps as soon as the water pressure failed on the engine jackets.

The thermometers that are used in the water discharge pipes from the cylinder heads can easily be provided with electric contacts to give a warning signal when the water temperature becomes too high; this prevents any accident due to careless manipulation of valves.

It is a simple matter to prevent any interruptions in service due to want of fuel. The fuel must be kept clean; to do this a series of strainers and filters should be used to protect the cleanliness of the oil from the time of its delivery into the main storage tanks until it passes through the spraying devices on the engine itself. The simplest type of fuel supply system is the ordinary overhead day-tank in the engine room, which is filled from the main storage tank once each day or once each shift. If the tank is large enough and is provided with some form of gage, there is no danger of the fuel supply running short. While it is quite feasible to fit a warning alarm on the day tank, it is seldom necessary.

Waste-gas boilers recover part of exhaust heat



The engineer uses the exhaust pyrometer to reveal engine conditions

In most plants the cost of pyrometer equipment to measure the temperature of the gases in the exhaust ports of each engine cylinder is well warranted. Such a device permits the exhaust temperatures of all the cylinders to be taken in a few seconds and is a most convenient check on everything that concerns combustion. It thus greatly facilitates efficient supervision. If the temperatures agree within a reasonable limit, the attendant is assured that each cylinder is doing its share of the work in proper manner. If one cylinder reads high, it is overloaded or has a leaking exhaust or spray valve. A low temperature, on the other hand, shows an underloaded or missing cylinder. The use of exhaust-gas pyrometers has greatly improved the general performance of multi-cylinder Diesel engines.

It is often practicable and economical to utilize the heat in the jacket water and in the exhaust gases. The larger part of the waste heat is in the jacket water, and where there is a use for water at a temperature of 140 or 150 deg. F. the jacket-water heat can be utilized directly. One instance of this is supplying feed water to fuel-fired steam boilers in a combination steam and Diesel power plant, this feed water being further heated by exhaust steam. However, a temperature of 140 or 150 deg. F. is often too low for efficient use; in such cases an exhaust-heat reclaimer can be placed in the Diesel exhaust line in order to raise the temperature of the engine jacket water to, say, 180 deg. The exhaust heater, in thus recovering 10 or 12 per cent of the heat in the fuel, raises to a useful potential the jacket-water heat, which represents about 27 per cent more. The upkeep of these exhaust heaters amounts to little, as they are subjected to low temperatures only, and the exhaust gases from a high-grade Diesel engine are cleaner than furnace combustion gases.

A relation worth noting is that when the jacket and exhaust heat are passed through recovery devices, one gallon of oil burned in a Diesel engine will produce 12 kw.-hr. of electrical energy and in addition the heat equivalent of 50 lb. of steam. This quantity of power and heat accounts for over 70 per cent of the heat in

Air filters used on Diesel intakes at Ponca City

the oil, comparing quite favorably with the efficiency of an ordinary fuel-burning steam boiler.

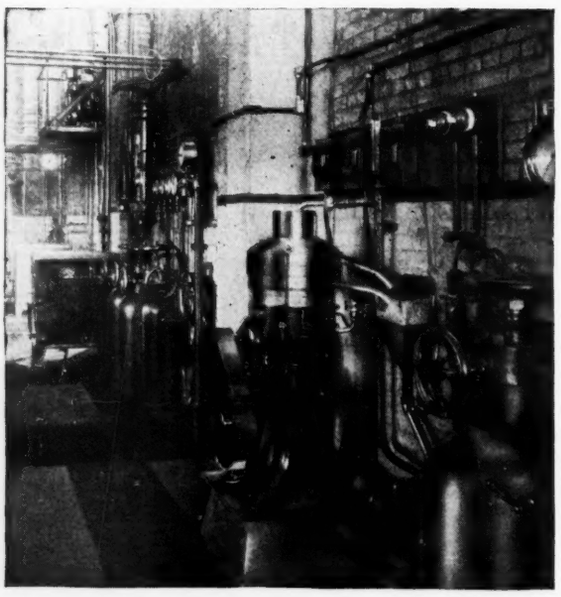
There is no reason why any objectionable noises should issue from a modern Diesel power plant. The elimination of noise is a matter of applying well developed devices in an intelligent manner. The application of Diesel drive to ice plants has greatly contributed to this improvement, as many such plants have been installed in high-class residential sections because of the advantage for delivery purposes of having the plant close to the consumers. Both the exhaust and the air-intake noises can be practically eliminated with compact silencers of the Maxim type. It is worth remembering that exhaust-heat reclaimers also act as effective silencers, because they subdivide the exhaust gases into long narrow streams and also cool the gases and reduce their volume.

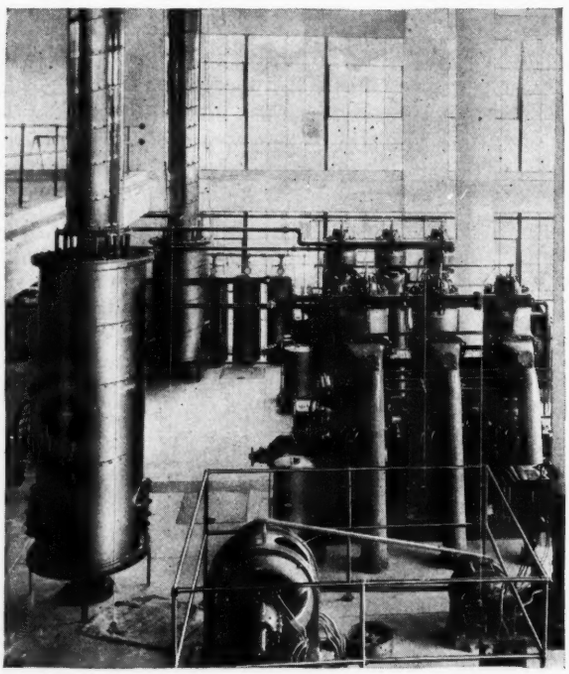
Silencing equipment can now be provided which imposes no harmful back pressures, occupies little space and is moderate in cost.

Complete freedom from transmitted vibration is inoperative in certain kinds of power-plant service. Vibrations can be reduced at the source by using engines of six or more cylinders with their cranks arranged for best balance and with their reciprocating parts having minimum inertia. However, it is not possible to eliminate completely all vibrations at the source, and to prevent those remaining being transmitted through the soil, cork mats can be used under the foundations. These mats are most effective when made of sections of natural cork three or four inches thick placed between the bottom of the foundation proper and the top of a concrete sub-base. In addition, the sides of the foundation block are isolated from the soil either by an air space or by cork. To prevent engine vibrations being transmitted to the building walls through the piping, each pipe line may be arranged with a flexible section where it connects to the engine, and the pipe lines may be hung on springs or cork supports.

The reclamation of used lubricating oil is ordinarily well worth while, this being done either by centrifuging or by chemical coagulation and settling. The centrifugal purification of fuel oil has demonstrated its value in large plants burning the heavier and dirtier grades of oil. Air filters of many types are available for removing dust from the air entering the engine and compressor cylinders. They are highly efficient and often save their cost in two or three years in reduced expenses for liner replacement and valve grinding.

Lubricating-oil centrifuges at South River, N. J., plant





An exhaust silencer and air-ventilated exhaust stack

Good judgment must be used in deciding what refinements should be incorporated in a Diesel power plant and in arranging them properly. Conditions vary in different plants and there are few general rules, consequently a special study is needed in each case. Unfortunately, in several instances such studies were not made and misfit plants resulted. Experience in many other plants has shown that careful planning is invariably repaid by large savings in operating costs and by improved plant performance.

Operating Experience Proves

PULVERIZED LIGNITE

A Satisfactory Fuel

By V. H. BRAUNIG

Superintendent, Electric Department San Antonio Public Service Company, San Antonio, Texas

THIS ARTICLE SUMMARIZES *the experiences of the San Antonio Public Service Company in burning Texas powdered lignite during the last three years at its Comal plant, in New Braunfels, Texas.*

FOR a great many years it has been recognized that the State of Texas has a potential supply of fuel that would be ample for the next several hundred years, provided it could be efficiently burned for modern industrial uses.

Many experiments have been made in the burning of Texas lignite on grate furnaces. In most cases only fair success has resulted. It does not store successfully in the lump form. After being in storage for a very short time, the lumps shatter and disintegrate and the coal virtually pulverizes itself, making it difficult to keep it on the ordinary grate surface. Large quantities of the unburned lignite drop through the grate even though the openings are made very small.

The successful burning of ordinary forms of Northern and Eastern coal by the pulverized method suggested to the engineers of the San Antonio Public Service Company that the same method might offer a solution to the burning of Texas lignite. Consequently, it was decided that if preliminary experiments were successful, a plant would be built to test out thoroughly this low-grade fuel.

In this introduction three years of experience in the burning of Texas lignite will be reviewed. This will be divided into two parts:

1. Has the pulverized method of burning Texas lignite been a success?

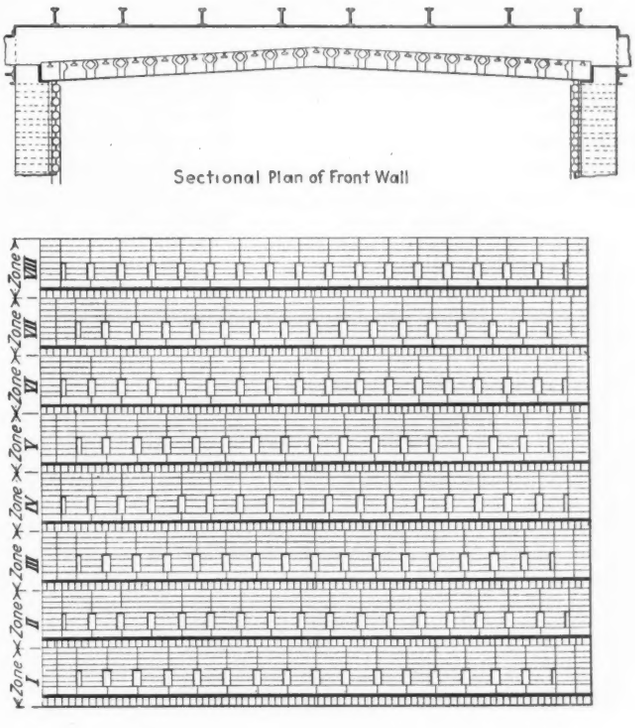
2. What troubles were encountered and how were these remedied?

The first question can be answered in short order. The experiments of the San Antonio Public Service Company and those of a neighbor company have demonstrated without a doubt that the burning of Texas lignite by the pulverized method is successful beyond the expectation of all engineers concerned at the early stages of this experiment.

This is a finding of tremendous importance to the Southwest, as it opens up unlimited possibilities for future industrial development in this area. Some of the reasons are: The State of Texas is underlain with vast deposits of lignite coal on lands that can be bought cheaply. The coal can be mined easily. The cost of lignite delivered in the plant yard has been less than the cost of gas or oil when averaged over a period of years. With these facts established this area can build for an industrial future with a sound foundation—something impossible with more uncertain forms of fuel supply.

It might seem that it would be foolish for anyone to attempt to use other forms of fuel for large power plants in this section. However, owing to the tremendous deposits of gas and oil in this state, there will be many times when it will be advantageous to burn gas or oil temporarily. The success with lignite to date indicates that Texas has an unlimited supply of cheap fuel in

Fig. 1—Elevation and sectional plan of air-cooled front-wall construction used in boilers for pulverized-lignite firing



reserve that will make it an industrial center long after the gas and oil supplies have been exhausted.

Success with lignite has not been accomplished without a great deal of costly experiment, and it has been necessary to overcome a great many minor difficulties. It is my intention to outline some of the many and varied problems encountered during the evolution of Texas lignite from its early classification as one of the poorest grades of coal on the continent into a practical and desirable form of fuel.

The different stages of the development of Texas lignite into a commercial fuel as conducted by the San Antonio Public Service Company were as follows:

1. The original experiment at St. Paul, Minn.
2. The building of the Comal plant. Design and installation of boilers No. 1 and No. 2.
3. Preliminary operation of boilers 1 and 2, establishing new facts.
4. Installation of boiler No. 3, approximately two years later, incorporating all ideas to date.
5. Final results with this last boiler and the rebuilt boilers 1 and 2.

Taking up these stages in detail:

In 1925 the San Antonio Public Service Company shipped nine cars of lignite from Texas to St. Paul, Minn., for the purpose of burning this coal in the Island station of the St. Paul Gas Light Company. The results of these tests, as witnessed by engineers from the Combustion Engineering Corporation, the U. G. I. Contracting Company, Day & Zimmermann, Electric Bond & Share Company, American Light & Traction Company, San Antonio Public Service Company, and the crew of the old St. Paul Gas Light Company, showed:

1. That lignite coal pulverizes easily, but contains a very large amount of moisture.
2. That the temperature of the gas leaving the driers and the temperature of the coal leaving the driers should be above the dewpoint of the gas to avoid condensation of the vast amount of moisture.
3. That the ash content is very high in lignite, the ash being extremely light and fusible.
4. That the coal feeders have to be larger for a given capacity, owing to the lower B.t.u.
5. That the bottom rows of the boiler tubes should be spaced wider than normal, so that the heavy deposits of ash on the tubes cannot bridge over.
6. That the furnace area should be larger to prevent molten ash being carried up into the boiler and solidifying on the tubes, making it necessary to carry the CO_2 in the boiler at a low figure; also to take care of large volumes of moisture and ash.
7. That the high moisture content of the coal and the impossibility of driving out this moisture successfully ahead of the boiler makes the efficiency that can be expected in an especially designed boiler approximately 80 per cent.

The results of this test were considered to be quite satisfactory, hence it was decided to design the boilers of the Comal plant for burning Texas lignite.

Standard equipment was adopted for crushing, drying, pulverizing, conveying and storing the coal.

The design of the boilers represents a departure from the standard practice. Fig. 2 is a sectional elevation of one of the two 20,000-sq. ft. 430-lb. boilers that made up the first installation. Special attention is called to the design of the combustion chamber and the ashpit. It will be seen that the rear wall and about two-thirds of the side walls are covered with fin tubes. The remaining third of each side wall and the front wall is of the "Detrick" hollow-wall construction through which the preheated air passes on its way into the furnace through ports in the front wall. The ashpit is protected, to some extent, from the heat of the flames by a row of water-screen tubes that run almost horizontally across the bottom of the furnace from the front to the rear. There are nineteen of these tubes, which is half the number of the rear-wall fin tubes. The water from each screen tube is divided between two rear-wall fin tubes by means of a three-way connection into which these tubes are rolled. There are 28 tubes in each side wall.

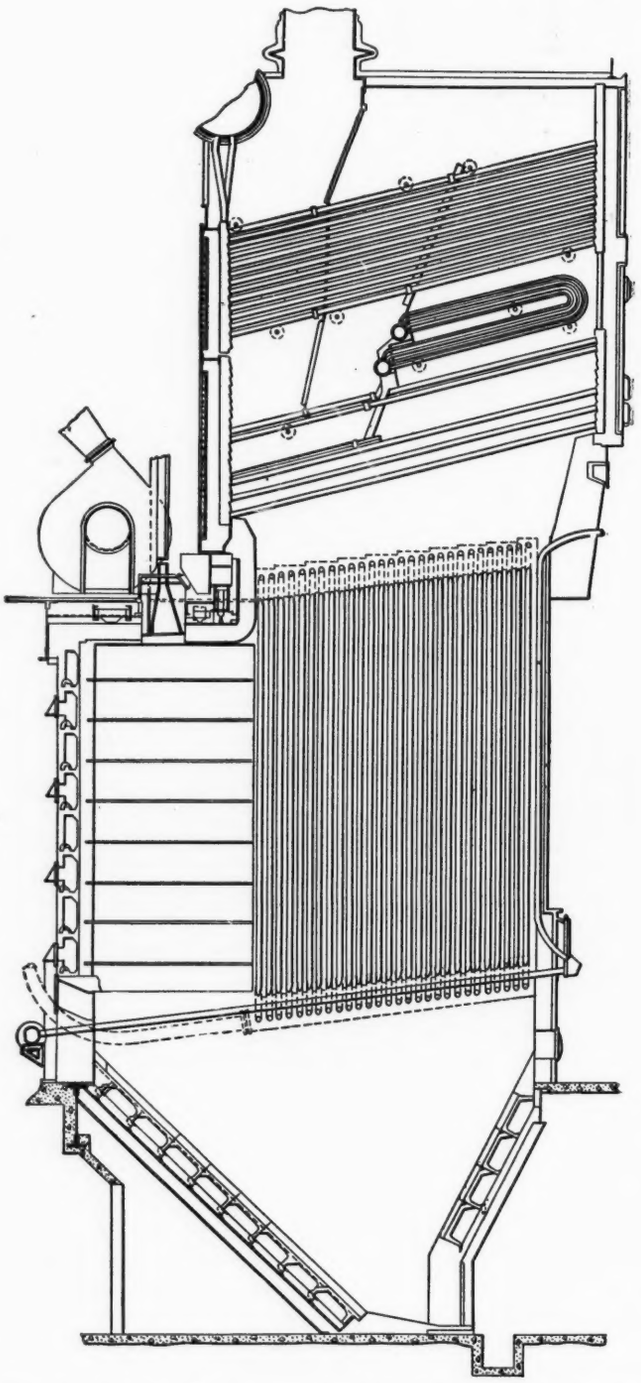


Fig. 2—Sectional elevation of original boilers built by the San Antonio Public Service Company for the burning of pulverized lignite

The powdered coal is fed into the furnace through twelve fishtail burners, which project vertically through the top of the arch. Air, under a pressure of from 10 to 15 in. of water, is used to blow the coal through the burners. When the coal stream enters the furnace and begins to burn, it is met by air coming through the ports in the front wall (these ports can be seen by an examination of Fig. 2). The air, moving horizontally, strikes the coal stream and causes it to turn, so that it will not go too low in the furnace before the hot gas starts to rise, and travel toward the first pass, which is at the rear of the furnace. The relative amounts of this air and that which comes in with the coal determine the contour of the flame.

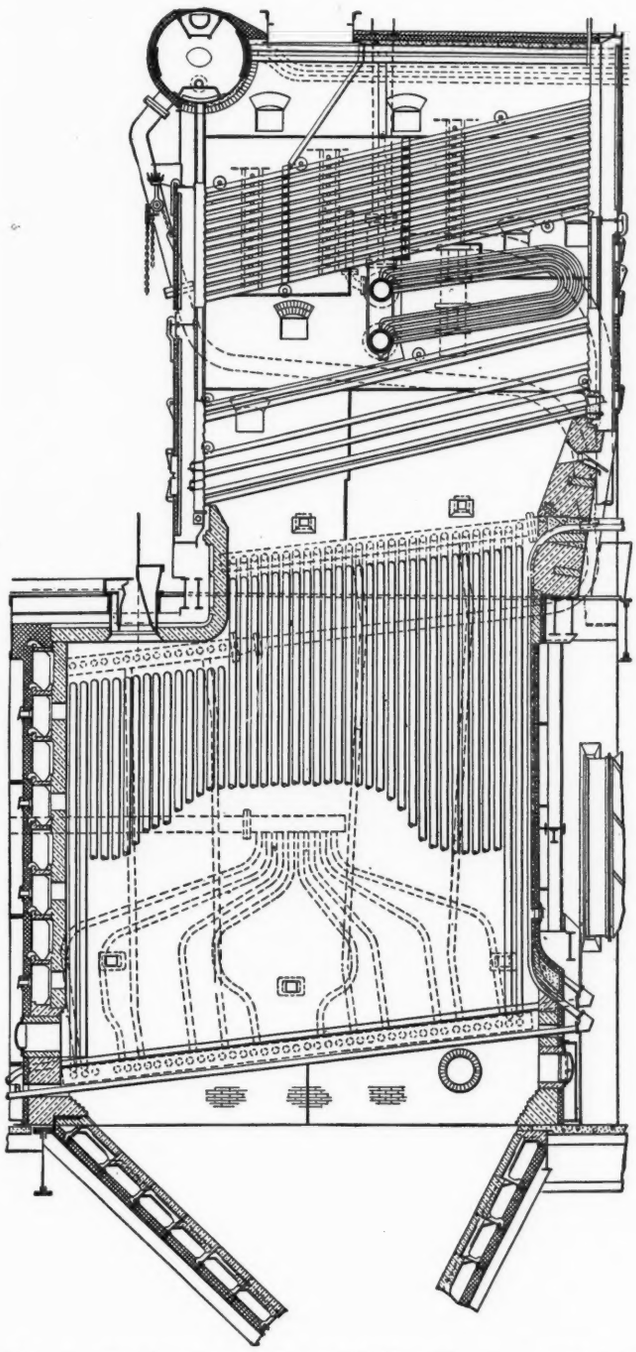


Fig. 3—Sectional elevation of boiler No. 3, in which is embodied the experience gained in the operation of the original boilers

In the bottom bank of the boiler tubes the second and fourth rows of tubes were left out. It was decided in the beginning not to remove every other tube, which procedure had been recommended as a result of the St. Paul experiment.

The first two boilers, shown in Fig. 2, were put into operation in the spring of 1927 and were fairly successful. The third, and last, boiler was put into operation in the early part of 1929. It is shown in Fig. 3. After several months' operation with boilers No. 1 and No. 2, additional facts were developed as follows:

1. The distribution of air through the front wall was not correct. Too many air ports made the velocity of preheated air, striking the down stream of the coal, too low. This was remedied by closing, entirely, the air ports in the bottom three belts of preheated air, as shown in Fig. 1, and by checking off about one-half of the area of the balance of the air ports, a brick being placed in each opening.

2. The spacing of the tubes in the bottom rows of the boilers was found insufficient, even with the elimination of the second and fourth rows, and it was decided that in future boilers additional spacing would be given.

3. It was seen that the water-screen capacity was not sufficient to cool the molten particles of ash as they dropped into the ashpit, so it was concluded that in future boilers this water screen would be doubled (Fig. 3 shows how it has been done).

4. It was found that no difficulties were experienced by cool furnaces on Nos. 1 and 2 boilers. In fact, the furnace had a tendency to get too hot. Consequently, it was apparent that the water walls in any future boilers should extend completely around the furnace. By examining Fig. 3 it can be seen how the water walls were extended around three sides of the furnace in the last boiler. The front wall was left with the air-cooled construction. The reason the front wall was not made entirely water cooled was because of the type of burner used.

5. The most serious difficulty encountered on the original boilers was the fan capacity, both induced and forced draft. This capacity was too small to give the rating expected by the designers on the original layout. The fan capacities on the original boilers were increased. The new boiler was designed with enough fan capacity. The increase in fan capacity enables all three boilers to be run up to their rating, 350 per cent normal.

6. It was found that the plate type of air preheaters clogged with ash at the point where the cold air first entered the preheater and met the hot gas. This produced a chilling effect and brought the gas below its dewpoint, depositing ash on the heater plates. The ash has slight cementing properties and clings tenaciously to metal surfaces when mixed with water and allowed to set. To overcome this it was decided that three things could be done: Design the next preheater with somewhat wider gas passes (this was done in the design of No. 3 boiler); provide enough space above the preheater so a man could enter and use a lance for cleaning purposes (this was carried out in the new design, also in the design for the installation of new fans on boilers No. 1 and No. 2); provide a bypass with a damper on the forced-draft fan to insure some of the preheated air being recirculated with the cold air through the preheater to prevent excessive clogging (this was done in the design of boiler No. 3 and was also applied to boilers No. 1 and No. 2).

7. It was found that most of our unusual troubles were

caused by the large amount of ash, about 90 per cent of which tended to go through the boiler. This accumulation must be prevented, and we have found that the mechanical soot blower becomes of increasing importance even though it has slightly changed its function from that of a remover of soot from the tubes to an agitator. The new function of the soot blower is to keep the ash moving through the boiler and not allow it to accumulate. It has been found necessary to operate the blowers at more frequent intervals—at present every four hours. By examining Figs. 2 and 3 it can be seen that in No. 3 boiler the soot-blower elements were spaced a trifle differently in an effort to find the strategic point of ash accumulation. This is important, as the successful stirring of the ash to keep it moving determines the number of hours the boilers can be kept in service without loss of capacity and superheat, or burning of tubes.

By incorporating all of the foregoing points in our latest boiler and also by the adoption of a new type rotary burner that was recommended by the manufacturer, we naturally expected great things from this boiler. And we have not been disappointed. In a recent test to determine these facts, the following results were noted:

The boiler was operated at a steam-flow rate of 245,000 lb. per hour for a period of 7½ hours, during which time the efficiency as calculated by the heat-balance method averaged 81.8 per cent. This steam flow is equivalent to 359 per cent rating for the boiler, superheater and furnace combined, or 7,515 developed horsepower. This compares with the manufacturer's guarantee of 232,000 lb. of steam per hour for a period of four hours and an efficiency of 79.5 per cent. The heat-liberation rate was 18,400 B.t.u. per hour per cubic foot of furnace volume, compared with a guarantee of 18,050. The temperatures of the flue gas leaving the boiler and preheater, respectively, were 630 deg. F. and 423 deg. F., compared with 640 deg. F. and 440 deg. F. on guarantee. The temperature of the air leaving the preheater was 469 deg. F., compared with a guarantee of 447 deg. F.

These results should not be confused with boilers using higher grades of coal. An ultimate analysis of an average sample of lignite is given below, showing the high moisture and ash content.

COAL AS FIRED AFTER LEAVING THE DRIERS

	Per Cent		
Moisture	29.05	Oxygen	11.24
Carbon	43.90	Nitrogen	0.75
Hydrogen	3.12	Sulphur	1.34
		Ash	10.60

Boilers No. 1 and No. 2, although brought up to date as far as practical to put them on a par with No. 3 boiler, will not perform quite up to the standard set by it, especially at the higher ratings. This is principally on account of coal feeders, improved slag screen, greater water-wall surface and preheater spacing. The performance of the first two boilers, however, is very satisfactory, as evidenced by the fact that the three boilers supply sufficient steam for two 30,000-kw. turbine-generators. Experience leads to the belief that these boilers can be kept in continuous operation, shutting down each boiler once every four months for cleaning.

A CORRECTION—Owing to a mistake in the original copy for an article entitled "The Effect of Cold Working on Boiler Drums," published in the June 18 number of *Power*, the name of H. S. Newlin as one of the authors was omitted. The list of co-authors of the article should have read: Frederick G. Straub, H. S. Newlin, H. LeRoy Whitney and R. K. Hopkins.

London Has Problem of Deleterious Flue Gases

BY A. C. BLACKALL
London, England

THE recently erected Battersea Power Station, in the very heart of one of London's most congested areas, has caused quite a controversy in the papers and among scientists as to the resultant smoke nuisance and the best methods of dealing with it. It is an example of the difficult questions that inevitably arise in the course of industrial developments.

The proposal to put down a large station in the center of a thickly populated district within easy reach of buildings of great historic importance, which have already suffered heavily from the ravages of a polluted atmosphere, has brought home to the public the problem of the acid gases emanating from the chimneys of industrial works. Owing to the freedom from soot these fumes appear harmless, but, in fact, they are extremely deleterious to many building materials, to metal work and to vegetation. The problem has considerably influenced the choice of the location of chemical works, and has led to strict regulations as to the nature of the gases that can be discharged into the atmosphere.

Take the case of a station consuming one thousand tons of coal daily, which may contain from 1 to 2 per cent of sulphur. Of this, about one-half comes off in the flue gases as sulphur dioxide, which in the atmosphere soon becomes converted into sulphuric acid. As the sulphur so emitted produces three times its weight of sulphuric acid, the combustion of one thousand tons of coal will result in the production of at least fifteen tons of acid. It is considered that the Battersea power station may be responsible for the production of as much as 30 tons of sulphuric acid per day, a formidable amount, especially as an addition to that which is already being produced, and of which we have careful measurements computed from the annual soot falls in the Metropolis.

In London the annual acid fall is of the order of 88 tons per square mile, totalling nearly 8,000 tons a year over the London area. Other stations are likely to be erected to meet the electrical developments anticipated in the near future. Quite obviously, something must be done to curtail the output of this acid.

Two suggestions have so far been made toward solving the problem. The first is to control carefully the composition of the coal used. This, however, militates against the use of low-grade coals, which is certainly prominent in the picture of future cheap electrical power. The alternative is the absorption of the gas by some type of alkali, with the vague hope that the product may find some kind of industrial application.

For every ton of coal consumed, however, there will be some 400,000 cu.ft. of hot flue gas, and a daily consumption of even 1,000 tons of coal means handling some 400,000,000 cu.ft. of these gases. Again, while the total content of acid is considerable, the proportion is small—probably not more than one-eighth of one per cent by weight. While chemical analysis might find no difficulty in extracting the gas with the available methods of intense absorption, the elimination of this small proportion from the unusually large volumes of flue gas is a totally different problem, and it will be interesting to see what are the results of the experimental work now being done in this direction.

Outwitting the Ions

"Silent" electricity protests violently, when a carbon-type circuit breaker (left) interrupts a current of 5,000 amperes at 125 volts. Such fireworks are eliminated by a remarkable new invention, the Deion circuit breaker

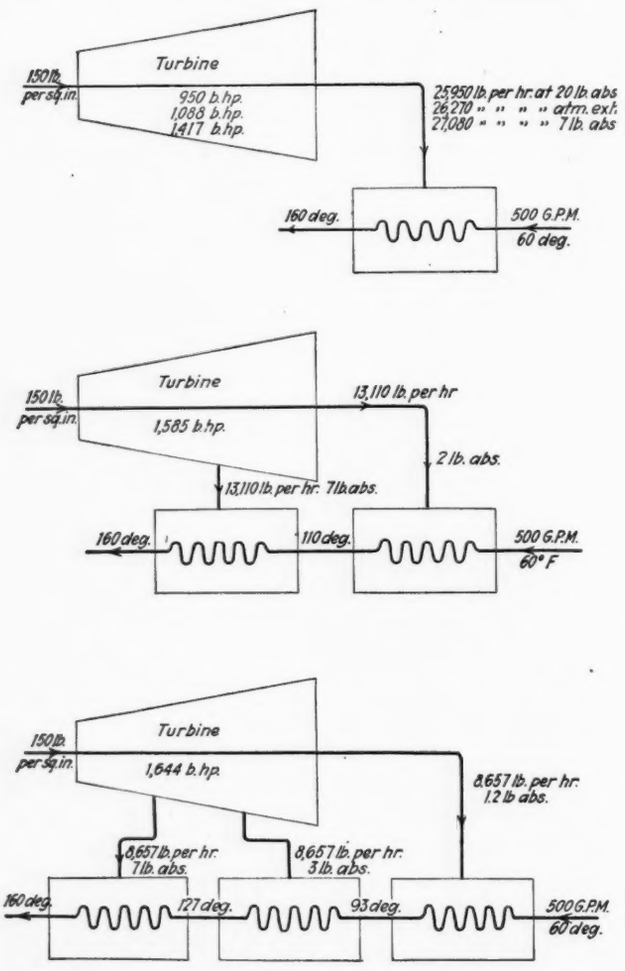
In the Deion circuit breaker the arc is broken into many small ones in the gaps of stack of spaced copper disks. Magnetically whirled at a speed of 2,400 miles per hour, while the ions are being trapped, the miniature arcs are extinguished when the alternating current passes through zero. The inventor, Dr. Joseph Slepian, research engineer of the Westinghouse Electric & Manufacturing Company, is shown examining the deionizing chamber of a single unit of the new breaker

Multi-Stage Water Heating Improves Economy of Bleeder Turbines

By M. D. Church
President Moore Steam Turbine Company

WHEN steam from a bleeder turbine is to be used primarily for heating water, it is possible to secure more byproduct power from the same steam by multi-stage bleeding and multi-stage water heating than by bleeding all the steam at one pressure. This is in line with the best central-station practice, but many industrial plants can realize relatively greater gains than possible in central stations, because of proportionally greater quantities of water to be heated.

As an example, suppose a quantity of water is to be heated from 60 to 160 deg. It is commonly considered



Turbines arranged for one-, two- and three-stage water heating

satisfactory to heat it with exhaust steam at 20 lb. abs. With a suitable heater it would be possible to heat the water with atmospheric exhaust pressure on the turbine and produce more power with the same steam. By running at seven pounds absolute exhaust pressure (about 15.67 in. vacuum) about 43 per cent more power could be developed with the same steam than at 20 lb. abs. back pressure. This is about as far as we can go in securing economy when heating water in one stage, whether by exhaust steam or by bled steam.

It is possible, however, to work more efficiently. A decided gain in cycle efficiency and in the amount of power that can be produced by the steam that heats the water can be made by arrangements such as shown in the illustration. In the second method shown half the steam does work down to seven pounds absolute and half down to two pounds absolute or 25.85 in. vacuum. The power produced by the turbine will be about 67 per cent greater than is produced by an equally good turbine or engine that exhausts against a back pressure of 20 pounds absolute.

In the arrangement for three-stage heating the turbine exhausts one-third of its steam at 7 lb. abs., 3 lb. abs. and 1.2 lb. abs. respectively, the last pressure being equal to about 27.55 in. vacuum. The power produced represents 73 per cent gain over the turbine at 20 lb. abs. back pressure.

The table gives approximate figures based on 150 lb. initial pressure, no superheat and the use of various arrangements for water heating. Turbine efficiencies are all taken at the conservative value of 60 per cent.

The heaters are all of the closed type, operating at 15 deg. terminal difference. For the single-stage heater the condensate temperature is assumed 10 deg. above the

TURBINE OUTPUT WITH ONE,- TWO-AND THREE-STAGE WATER HEATING

No. of Stages	Heater	Heater Pressure, Lb. Abs.	B.t.u. Available for Power	B.t.u. Converted to Power (At 60% Eff.)	B.t.u. Remaining per Pound Steam	Assumed Condensate Temperature	B.t.u. to Water per Pound Steam	Pounds of Steam to To Heat 500 Gpm. 60 to 160 Deg.	Pounds of Steam per B.h.p. Equiv. to B.t.u. Converted	Developed B.h.p.
1	1	20	155	93	1,102.0	170	964.	25,950	27.35	950
		14.7	176	105.5	1,089.5	170	951.5	26,270	24.12	1,088
		7	222	133.3	1,061.7	170	923.7	27,080	19.1	1,417
2	1	7	222	133.3	1,061.7	...	.....	.....	.....	....
	2	2	290	174.0	1,021.0	120	.....	.....	.....	....
	..	....	...	153.6 Avg.	1,041.3 Avg.	120	953.3	26,220	16.55	1,585
3	1	7	222	133.3	1,061.7	...	.....	.....	.....	....
	2	3	268	160.8	1,034.2	...	.....	.....	.....	....
	3	1.2	315	189.0	1,006.0	103	.....	.....	.....	....
	..	....	...	161.0 Avg.	1,034.0 Avg.	103	963.3	25,970	15.8	1,644

leaving-water temperature. In the multi-stage heaters the condensate is passed through succeeding heaters and is assumed to leave at 10 deg. above the exit-water temperature of the heater at the lowest pressure.

In many cases where exhaust steam is now used for water heating it is possible to put this same low-pressure steam through a suitable multi-bleeder turbine and multi-stage water heating system, and to develop a profitable amount of additional byproduct power. The turbine may be of either the low-pressure or mixed-pressure type according to requirements. The mixed-pressure type can be automatically controlled to make full use of all exhaust steam available before using any high-pressure steam.

The steam requirements for water heating will seldom exactly balance with load requirements for the turbine. There are several methods of taking care of this point, and the method used depends on the conditions encountered. The large gains possible when quantities of water must be heated justify full consideration of proper methods of application.

Central stations have made large gains in plant economies by the stage heating of water. Industrial plants should take full advantage of similar possibilities in connection with their water-heating problems. The advantages to be secured from multistage bleeding is not limited to water heating, but can be applied to any industrial process that will permit heating with steam in more than one step.

The Watch Engineer Is the Active Head of the Power House

Here is a standard instruction for the duties that go with this important power plant position

By Walter N. Polakov*
Consulting Engineer, New York City

Preceding instructions in this series were published in *Power* for May 14 and 21, 1929. When completed, the series will give a standard management procedure which is the result of many years' experience on the author's part and which is now in successful use in many power plants.

DEPENDING on the size of the plant and the hours of operation, the chief operating engineer has assistants operating different watches on his responsibility. In larger plants, working 24 hours, the chief operating engineer usually has three watch engineers and does not operate the machinery personally. In the smaller ones he may have a night engineer, running the plant at night, etc.

Duties of Watch Engineers

The duties of every watch engineer are the same, namely:

1. To operate all engines, auxiliaries and accessories with the best economy and without interruptions.

2. To keep records of operating units in the engine room as well as all records regarding supplies and materials used, repair work done and correct way of reading and recording all meters in the engine and boiler house.

3. To keep time of all employees changing shifts or changing jobs during the shifts (see standard practice instructions on Time Keeping).

4. Specifying the time and the location of maintenance work in the power house and on distributing lines,

Except the maintenance work in the boiler house.

5. To act for the chief engineer in his absence, when delegated to do so.

6. To exercise every effort to distribute the load between the units so as to consume a minimum amount of steam.

Responsibilities: Watch engineers are responsible to the chief operating engineer for:

1. Efficiency and uninterrupted operation.

2. Correctness of records which they are assigned to keep.

3. Discipline, order, safety, and cleanliness.

4. Maintenance of equipment in readiness for service and in best operating condition possible.

Authority: To these ends they have authority to:

1. Put in operation or stop any unit or auxiliary, *Except* those in the boiler house under the head fireman's jurisdiction.

2. To do all electric switching, operate valves, etc., *but* they have *no* authority to delegate these duties to anyone.

3. Draw supplies and materials needed for operation from chief operating engineer or storekeeper.

4. Exercise such authority as chief operating engineer has *if* and *when* specifically designated to do so in his stead, *Except* they have no authority to employ or dismiss anyone, *but* they have the authority to suspend any employee subject to chief engineer's final decision.

Condition of Work: A watch engineer cannot leave the power house at the change of shift until the next watch engineer reports to his duties and not until *after* the incoming watch engineer accepts the shift. Watch engineers have no right to leave the engine house without leaving a responsible substitute on the floor, and if they must leave premises, even for a few minutes, they must make an entry on the log, writing time when leaving, where they can be located, and the reason for leaving, and upon their return mark time when returned. The neglect to do so will call for discipline.

Co-operation: 1. Watch engineers should co-operate with head fireman on the matters of expected fluctuation of load, notifying them of stopping and starting engines beforehand, etc.

2. They should co-operate with head fireman regarding operations and the upkeep of any boiler auxiliaries during the watch.

3. With all persons who are making repairs or doing other special work in the engine house for the purpose of expediting repairs, promoting economy, enforcing safety, and maintaining proper discipline.

Correction—The word "header" appeared as "heater" in an article entitled "Interstage Reheating," in the May 28 issue, page 888. This should have read: . . . "As it takes its supply of live steam from the high-pressure steam header and not from any one particular boiler."

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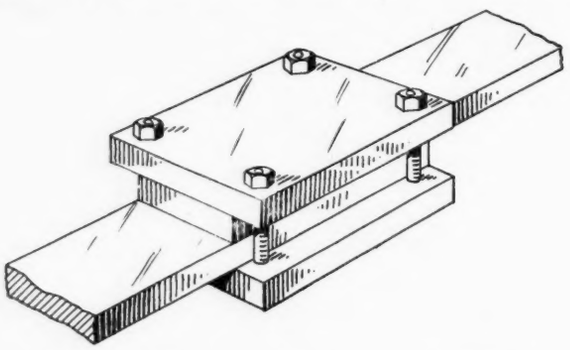
Right Out of the Plant

Making Joints in Aluminum Busbars

ALUMINUM busbars are to some extent replacing copper, for which they provide an efficient substitute. I have found the best joint for these busbars to be one that laps, as in the figure. The joint is clamped between plates as shown. It is not advisable to drill the bars and attempt to clamp them direct. The bars should overlap from ten to twelve times their thickness.



Type of joint used in aluminum busbars

A smaller overlap than this will increase the resistance and may cause an unsatisfactory joint.

When the bars are ready to be jointed, the two contact surfaces should be coated with vaseline and then rough filed. The vaseline is not removed, but the two bars should be immediately clamped together. The pressure will squeeze the bulk of the vaseline out. This treatment is necessary on account of the film of oxide that forms quickly on any aluminum surface exposed to the atmosphere. If the surfaces were first cleaned bright and then clamped, the oxide that would immediately form would cause a defective joint. Aluminum joints are highly resistant to electrolytic corrosion, but the joints should be painted so as to exclude moisture.

An important point is to make ample provision for expansion. For a given change in temperature, aluminum expands or contracts more than copper; consequently, for a given temperature change, it requires a more liberal provision for expansion and contraction.

Brentford, England. W. E. WARNER.

Losses in Draft-Gage Pipe Lines

IN VIEW of the many inquiries received by our company relative to lag and pressure losses in draft-gage pipe lines of great length, experiments were made recently on 500 ft. of $\frac{1}{4}$-in. bore copper tubing in 50-ft. lengths, coupled with short pieces of rubber tubing. Two calibrated Ellison inclined draft gages of 1-in. range, 10-in. scale, with a tube inclination of approximately 1 in. in 10 in., were used in parallel. One gage was connected with the source of pressure by the 500 ft. of copper tubing referred to, and the other gage was connected with a short piece of rubber tubing.

Under repeated experiments of 1-in. pressure quickly applied to the two gages simultaneously, with a liquid travel of 10 in. in the two gages, the time lag in the 500-ft. line was 10 seconds when the two gages checked precisely. In releasing the 1-in. pressure, the lag in the long pipe line was 20 seconds when the liquid in both gages stood at zero. A sudden change in pressures of $\frac{1}{2}$-in., minus or plus, between the $\frac{1}{4}$-in. and $\frac{1}{2}$-in. readings on the scale, gave a lag in the long line of from 5 to 10 seconds when the gages checked exactly.

From the foregoing experiments it is evident that pressures in draft-gage pipe lines of 500 ft. length and of $\frac{1}{4}$-in. bore are correct and that the time element is well within the requirement of ordinary draft measurements.

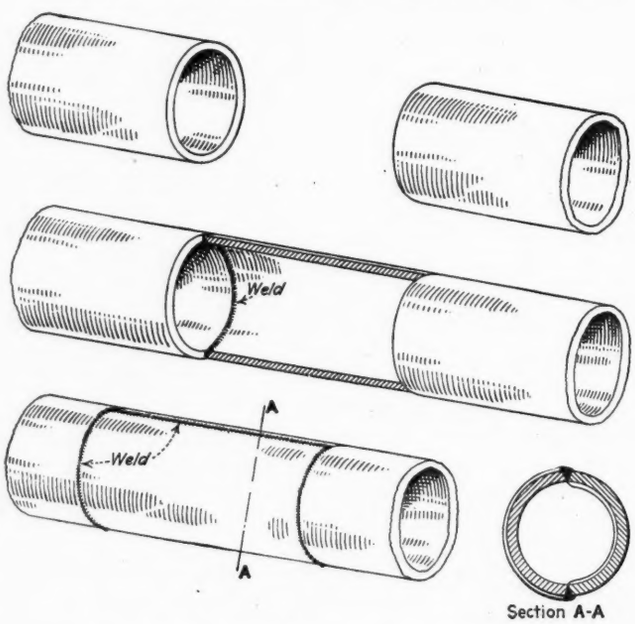
LEWIS M. ELLISON,
Chicago, Ill. Ellison Draft Gage Company.

How an Inaccessible Pipe Was Repaired With the Aid of a Welding Torch

SOME time ago I had a pipe repair problem which was successfully overcome, and it occurred to me that the method used might be helpful to other readers.

Repairs to a steamer had been under way for a few days previous to sailing. On the last day attention was called to a porous section of pipe in the exhaust line to the feed-water heater. For some reason the pipe was badly pitted for about a foot and leaked some after being tapped with a hammer to test its thickness. It was impossible to get pipe of that size locally, so some means of repairing it had to be devised.

The pipe was in an inaccessible place and to renew



One half of pipe patch was welded from the inside, other half from the outside

it, if pipe had been available, would have taken a couple of days. Fortunately, a short section of pipe the same size was found in a scrap pile. This short section was split in halves lengthwise. The half that went against the side of the ship was beveled on the inside, then it was set in and welded in place, butting both ends against the old section of pipe. The welding had to be done

from the inside because there was not room enough to do it from the outside. After this half-shell had been welded in place, the other half was placed against it and welded in from the outside. A tight job was made and it required much less time than if a new section of pipe had been put in.

P. W. LAMSON.

Roselle, N. J.

A Continuous Gas Sampler

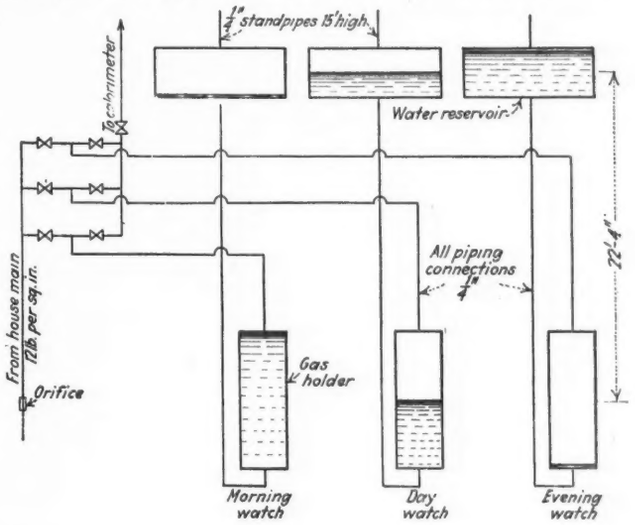
WHEN the natural-gas supply in southern California increased to the point where prices were comparable with fuel oil, many plants changed fuels and new problems were encountered in arriving at suitable and equitable prices of gas. Orifice meters are quite generally used for metering and present no particular difficulties. In our own case we entered into a contract for gas fuel in which the price per thousand cubic feet varied directly with the heat value of the gas. Samples were to be taken and tested for B.t.u. value and the price pro-rated on a basis of 1,100 B.t.u. per cubic foot as standard. Everything worked out fine as long as the gas remained at a fairly constant heat value, but when the firemen began to notice periods when the gas pressure on the burners had to be suddenly and vastly increased in order to hold the steam pressure for a constant load, we began to have misgivings as to the fairness of the method by which we were being charged for gas. Samples were taken three times a week by the gas company, and the heat values reported by them remained fairly constant.

About that time the idea of buying a gas calorimeter and checking gas values ourselves was advanced and carried out. It was discovered that the heating value of the gas did fluctuate considerably, in fact sometimes as much as 25 per cent. From three gas tests per week we had advanced to two per day, but since these tests were made during the day shift, our own test averages were prone to be in error due to changes in the gas during the evening and early moring shift. There were several ways to get a true average B.t.u. value throughout the 24 hours, but the simplest and most inexpensive appeared to be a device for taking a continuous sample and storing it until a calorific test could be made at the leisure of the laboratory man.

Two sets of three tanks were welded up out of some light-weight $\frac{1}{16}$-in. casing, using $\frac{1}{4}$-in. plate for heads. These were piped up as shown in the illustration and the lower tanks filled with water; since the pressure on the house main is held fairly constant at about 12 lb., the upper tanks were located 22 ft. 4 in. above, thus requiring 10 lb. pressure to displace the water from the gas holders below to the water reservoir above. One-quarter inch standpipes were run up ten or fifteen feet above the upper tanks in order that an unusual rise in gas pressure would not cause the water reservoirs to overflow. All piping connections are $\frac{1}{4}$ in., and the holders were designed to hold approximately 8 cu.ft. of free gas. This amounted to a little less than $4\frac{1}{2}$ cu.ft. at 12 lb. pressure. It is quite important also that the lower tanks be made of slightly greater capacity than the upper ones in order that all the water will not be forced out of them before sufficient head is obtained in the standpipe to balance the gas pressure.

A quarter-inch connection brings the sample from the house main to a manifold, from which it can be directed into any one of three holders. Three shifts, or watches, are maintained and each one fills a holder. When the holder is filled, the sealing water has all been forced into the upper reservoir and by virtue of the pressure it exerts due to its elevation, the stored gas for each watch can be bled off to the calorimeter at will and tested for heat value. In this way it is possible to figure accurately the B.t.u. per kilowatt hour consumption for each watch. As each fireman comes on duty he closes the sampler valve leading to the holder filled by the previous watch and opens the valve to his own holder. Since the gas sample is being taken continuously from the house main, the collecting holders may be located at any convenient distance without affecting the accuracy of the results. The rate of flow of the sample is regulated by means of an orifice or other restriction placed in the sampler line.

After several experiments as to the proper sized hole to admit just enough gas to fill a holder in eight hours, we hit on the idea of placing a piece of copper capillary tubing (from a discarded curve-drawing thermometer) in a $\frac{1}{4}$x2-in. nipple and filling the nipple with lead. The



Arrangement of water reservoirs and interconnecting piping

hole in the tubing had a diameter of possibly 0.020 or 0.025 in., and was found to be slightly large. By partly obstructing the hole in the tubing with pieces of fine copper wire, we soon had the gas flow regulated so that it took just eight hours to fill an 8 cu.ft. (free gas) holder to 12 lb. pressure. The apparatus is inexpensive, easy to construct and operate, and gives average results that are quite acceptable.

Pasadena, Calif. O. H. HEDRICH.

Flat Versus V-Shaped Belts

HAVING read the article by Ward Raymond, in the April 2 number on "Motor Drives for Air Compressors," I should like to say a few words regarding tests that have been made on the type of fabricated belts to which Mr. Raymond refers.

No doubt this type of belt pulls well, but it seems to be believed by many modern belt users that the V-shaped belt outpulls all flat belting, which, in my opinion, is not correct.

Exhaustive tests were made in 1928 by Professors C. A. Norman and G. N. Moffat, of the engineering experiment station of Ohio State University, comparing V-shaped fabricated belting with flat belting. In fact, they compared all sorts of belts—leather, hair, canvas,

balata and rubber, as well as rubberized V-belting. The results of the experiments have been published in bulletin No. 41, entitled "Transmissive Power and Stretch of Belting," which is obtainable from the engineering experiment station for 25 cents.

The results as published in the bulletin tend to show that a high-grade leather belt is superior to a V-shaped fabricated belt. In fact, solid woven cotton belting is superior within its limitations, Mr. Raymond says:

> As these belts wedge into the grooves, their coefficient of friction is high and consequently the motor and compressor sheaves may be run on close centers without the use of an idler pulley.

In my opinion, there is no difference between the coefficient of friction of a rubberized V-belt and a rubberized flat belt, but owing to the wedge shape of the groove the surface of the V-shaped belt is pressed against the groove with greater force than is a flat belt, consequently a higher pull may result. High-grade leather belting, solid woven cotton, hair and balata, all have higher coefficients of friction than rubber.

Mr. Raymond also says:

> Owing to the wedging action of the belts in the grooves there is no slippage, and grit or dust does not have a cutting action on the surface of the belt.

According to the experiments of Professors Norman and Moffat, V-belts *do* slip. And regarding wear I am copying verbatim the following from their bulletin:

> The rubber coating wears off the belt very rapidly, but the power transmission seems, if anything, more dependable after this has taken place. The belt, at least when run in and normally loaded, can be run quite slack without the slip exceeding 2 per cent. This seems true particularly at fairly high speed. It also permits a considerable overload. On the new belt the load was run up to 100 per cent above normal (179.5 lb. effective pull) without the slip exceeding 2 per cent even when the tension ratio was as much as 7. Desired steadiness of running may, however, render such high transmission ratios inadvisable.

Newark, N. J. W. F. SCHAPHORST.

Cost of Preparing Powdered Coal

I HAVE looked over the letter by Henry Kreisinger, appearing in the Jan. 15 number on the subject of "Cost of Preparing Powdered Coal." I have also read the editorial referred to, which appeared in the Oct. 23, 1928, number. The editorial seems to me to be a very pertinent one, and it certainly does not imply that powdered coal is never justified. It simply suggests that the average buyer would be wise and the engineer would be wise in carefully considering the matter before adopting it. I think Mr. Kreisinger has somewhat misconstrued the meaning of the editorial.

It is difficult to interpret correctly the charts such as Mr. Kreisinger offers without knowing the foundation for the data, although it is quite obvious that the plants are not on a literally or directly comparable basis. Power plants, it seems to me, can never be compared with each other without using some factor that will put them all on the same plane for a basis of comparison. In this case it appears that the plants are even farther apart in their character of loads, fuels, etc., than might usually be the case.

The cost of coal with underfeed stokers is high in the three instances in which Mr. Kreisinger has given this information. Obviously, it would appear, to that extent at least, that the underfeed-stoker plant is hampered in over-all costs. The load factor in the underfeed-stoker plant is materially lower than in the powdered-coal plants.

It will be noted that the cost of coal and the power production cost of the powdered-coal plant in the plant that has the lowest cost is 0.13 of a cent, and in the plant that has the highest, 0.30 of a cent, or more than double. If, in comparing one powdered-coal plant with another, the production cost can vary more than 100 per cent, how can plants be compared with each other without some factor being applied which reduces them all to precisely the same basis of comparison? The real fact of the matter is that wherever these comparisons are properly made, even by those who are exponents of powdered-coal firing, the stoker plants' first cost is substantially less. Certainly, an underfeed-stoker plant's first cost is substantially less, and surely, as far as the thermal results from the boiler room are concerned, we can find no substantial difference, even though the power required in the powdered-coal plant is not chargeable to its cost of fuel preparation. If we deliver steam to the turbine room at a lower cost, both in terms of first cost of plant and in cost of production, we do not see why we should be saddled with any turbine-room comparisons.

Under the heading of "Underfeed Stokers" I note that there is a plant that is 100 per cent complete, of 335,000 installed kilowatt capacity, consisting of eight turbine units. This plant has a production cost of approximately 0.5c. per kilowatt. It has a cost of plant in dollars per kilowatt of a little over $100. There are three powdered-coal plants mentioned, which are under this cost, one of which is 37 per cent complete, the other 50 per cent complete and the third one 25 per cent complete.

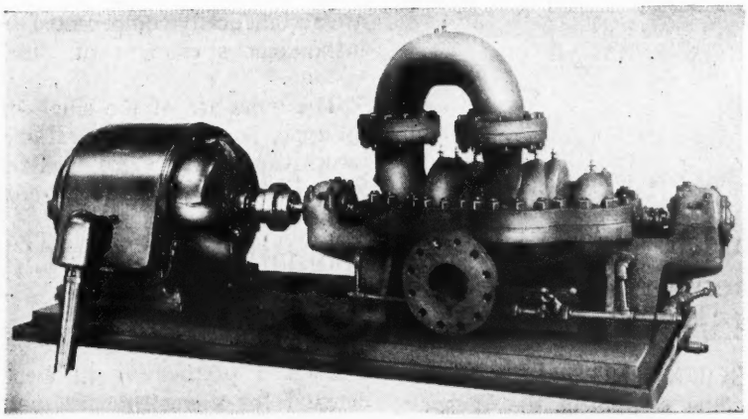
It does not seem possible that any plant of their respective sizes could be of a lower first cost in that state of completion than a plant of the size mentioned with the underfeed-stoker; nor does it seem possible to determine what the first cost of a plant in that state of completion is without making some allowance for that portion of the plant which necessarily is usually constructed for the ultimate development, such as coal storage and the like. When those kinds of factors are introduced in the calculation of the cost of a plant, it is always difficult to tell how accurate they will prove to be when the plant is finally completed.

Referring again to the underfeed-stoker plants that I mentioned, the load factor of the plant is less than 10 per cent. It seems incredible to me that in a plant of that size running at such a low load factor, they could secure such a low production cost. In all these matters, moreover, there enters into the question whether the kilowatt capacity of the plant is based on its production in terms of send out or in terms of total generated, or in terms of the rating of the generators, or some other arbitrary rating; or whether or not it can actually produce the amount of current that it is rated at. In the case of the 335,000-kw. plant with less than a 10 per cent load factor there is certainly an enormous amount of stand-by service in that property.

Philadelphia, Pa. J. G. WORKER,
Assistant to the President,
American Engineering Company.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES



Gould four-stage centrifugal pump

High-Pressure Multi-Stage Centrifugal Pump for Boiler Feeding and Other Services

THE adoption of high-speed (3,540 r.p.m.) opposed impellers to reduce end thrust and the use of double-guided glands are important features of the new high-pressure multi-stage centrifugal pump announced recently by Goulds Pumps, Inc., Seneca Falls, N. Y. The new pump is especially adapted to boiler feeding, general water supply, pipelines and similar services, and is made in capacities from 400 to 1,200 gal. per min. for pressures up to 600 lb.

The adoption of the higher speed permits the use of smaller impellers and smaller shafts, with consequent reduction in the area on which any unbalanced end-thrust loads would play and in the surface area of the shaft to be packed. Also, at high pressure and relatively small capacities better efficiencies are obtainable with the higher speed. It also gives a smaller unit for a given capacity than is obtained with pump running at the usual speed of 1,750 r.p.m.

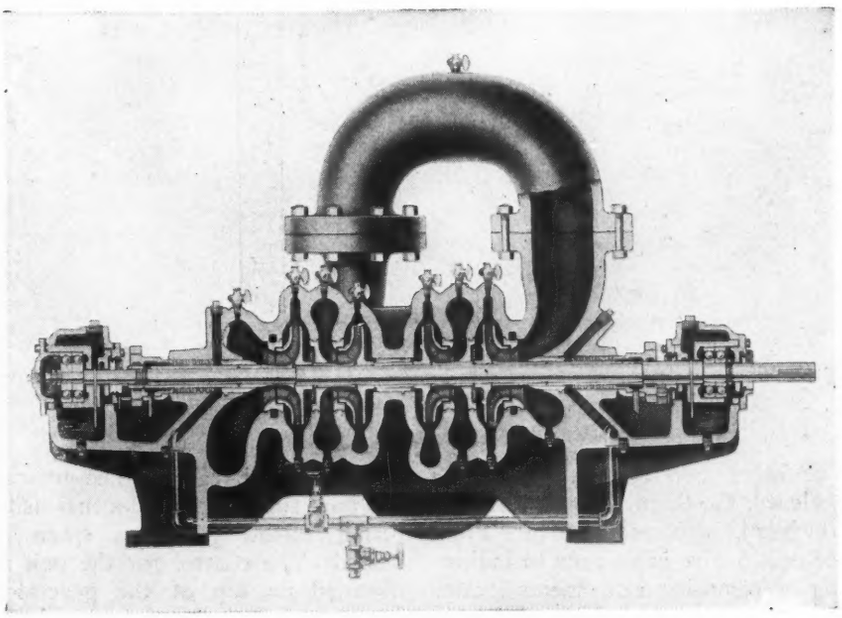
The pump casing, of cast-iron alloy, is split horizontally, with the suction and discharge connections in the lower half. The impellers, which are of bronze, are of the inclosed type and are opposed in pairs to eliminate end thrust at all ratings. Another advantage of the opposed impeller arrangement is that only one-half of the pressure produced by the pump is on the discharge stuffing box. The shaft is carried in deep-groove double-row ball bearings, ring oiled, the outboard bearing being arranged to take care of any unbalanced thrust on the shaft. The bearing housings are cast integral with the lower half of the pump casing.

Stuffing boxes are fitted with double glands guided at both ends to prevent cramping the gland on the shaft. The outer guide has a detachable cap that permits removal of the gland proper for inspection or renewal of packing. The packing space is unusually deep and has at the bottom, or inner, ends a long bronze bushing and water seal combined. The seals are interconnected, and valves are provided for controlling the pressure on each stuffing box to meet best the operating conditions.

Rotary Positive Blowers With Roller and Ball Bearings

THE P. H. & F. M. Roots Company, Connersville, Ind., announced the adoption of anti-friction bearings on its line of two-impeller, rotary, positive-displacement blowers. The standard line carries heavy-duty roller bearings, and the Acme line of smaller units, roller or ball bearings.

In addition to fitting the anti-friction bearings, the blower construction has been redesigned and improved. All bearings are fully protected from dirt, and provision is made in the design for forcing the lubricant through the bearing from one side to the other. It is pointed out by the manufacturer that the adoption of anti-friction bearings offers new possibilities for direct connection to smaller motors with less horsepower for a given capacity and also gives higher efficiencies since it permits the use of more closely fitting cases or housings.



Cross-section of pump showing arrangement of opposed impellers

Improved Method of Installing CO_2 Meters

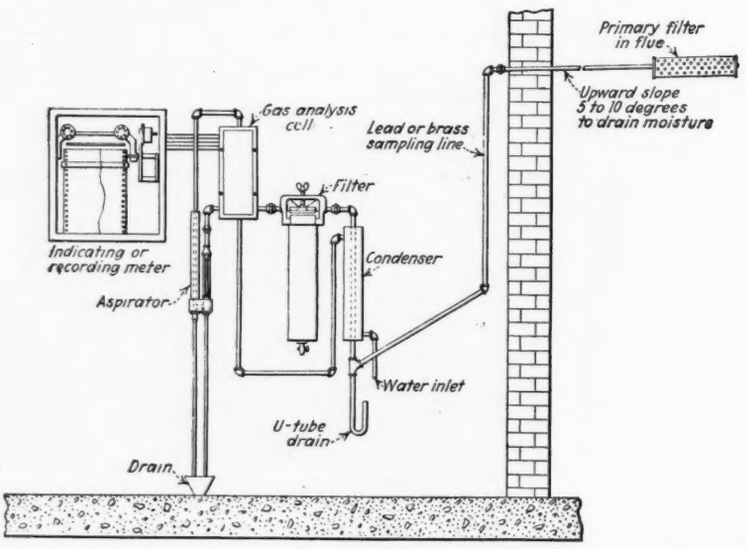
WITH a view to eliminating the causes for trouble in the operation of its CO_2 meter, due to clogging and gas leaks, the Brown Instrument Company, Philadelphia, Pa., has introduced the method of installing the apparatus shown in the accompanying illustration.

A primary filter consisting of perforated metal supporting asbestos cloth, projects into the flue or furnace. The pipe supporting this primary filter slopes downwards from the filter so moisture is drained off.

The sampling line runs directly down to the U-tube drain which collects moisture and acid from the gas sample.

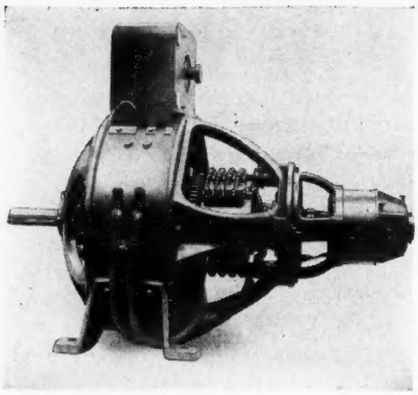
The gas then passes through a condenser, where it is cooled to prevent any accumulating of moisture in the analysis cell. A union connection is made in the sampling tube at a convenient point so the primary filter can be blown out occasionally with compressed air. A secondary filter, consisting of a container with steel wool and cotton, is placed in the line in front of the cell.

The thermal conductivity cell contains four platinum filaments of comparatively heavy wire mounted in gold plated cells with gold lined passages. Two of the cells contain air.



Arrangement of connections between boiler flue and instrument

The other two contain gas to be analyzed, the thermal conductivity of which is to be compared to air. From the cell, 5-wire cable runs to indicating or recording instruments located at any convenient point and calibrated directly in per cent CO_2.



400-ampere welding generator

Complete Line of Welding Generators in Single- and Multiple-Operator Types

IN ROUNDING out its line of welding equipment the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently brought out new 300- and 400-amp. single-operator arc- welding generators of the belted and coupled type which may be used where driving power such as motors, gasoline engines or lineshafting are already available. Speeds of 1,750 and 1,450 r.p.m. clockwise and counterclockwise rotation provide ratings for practically every application.

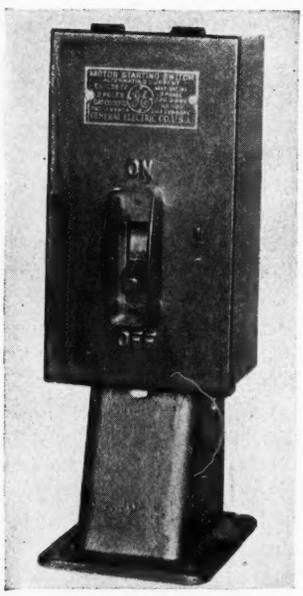
The complete unit includes a generator, direct-connected exciter, control panel, and reactor. The generators have small over-all dimensions to permit mounting where space is limited. The control for the unit is mounted on top of the generator frame and is inclosed by a sheet-metal cabinet. The welding current range of the 300 amp. unit is 90 to 375 amp., while that of the 400-amp. unit is 120 to 500 amperes.

The generators are all special type SK, single-operator, constant-current, differentially compound-wound, separately excited machines. Owing to the separate excitation feature, variations of arc length or intensity are automatically compensated for by instantaneous changes of generator voltage.

The units are of the single-operator type, but multiple-operator generators can be furnished in standard 500-, 750- and 1,000-amp. ratings.

Small Across-the-Line Starter

A NEW manual starting switch designed particularly to meet the demand for a small device that will throw motors across the line is illustrated. The device consists of a tumbler switch and two small thermal cutouts mounted on a common textolite base. By means of suitable interlocks the switch can be locked in either the open or closed position.



Single switch on pedestal

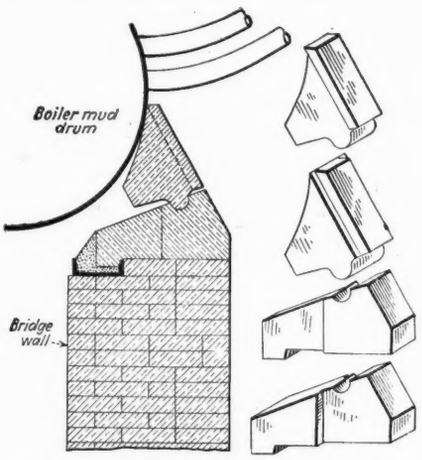
Single or double pedestals on which the switches can be mounted in positions near the controlled machines are also available.

The links of the thermal cutouts are made of tinned copper and the contact spring and post are also tin plated to prevent oxidation. The switch which has a rating of one horsepower at 110 volts and two horsepower at 220 to 600 volts, three phase, is manufactured by the General Electric Company, Schenectady, N. Y.

New Bridge-Wall Seal

WITH a view to overcoming the disadvantages of the standard form of bridge-wall construction for service with the bent-tube type of boiler, the new design shown in the illustration has been brought out by Michael Liptak, 1603 University Ave., St. Paul, Minn.

In the usual construction the bridge wall is built up nearly to the mud-drum center and corbeled off at the top to conform to the shape of the drum. The intervening space between the brick and the metal is filled with asbestos or other material to prevent air infiltration into the furnace, or bypassing of the hot furnace gases to the outlet, depending upon the arrangement of the setting. The one objection to this construction is that it is too rigid. With alternate heating and cooling there is more or less movement of the drum, which eventually tends to cause cracks in the brickwork, if not complete destruction of the upper portion of the wall, through which leakage may take place, thus lowering the efficiency of the unit.



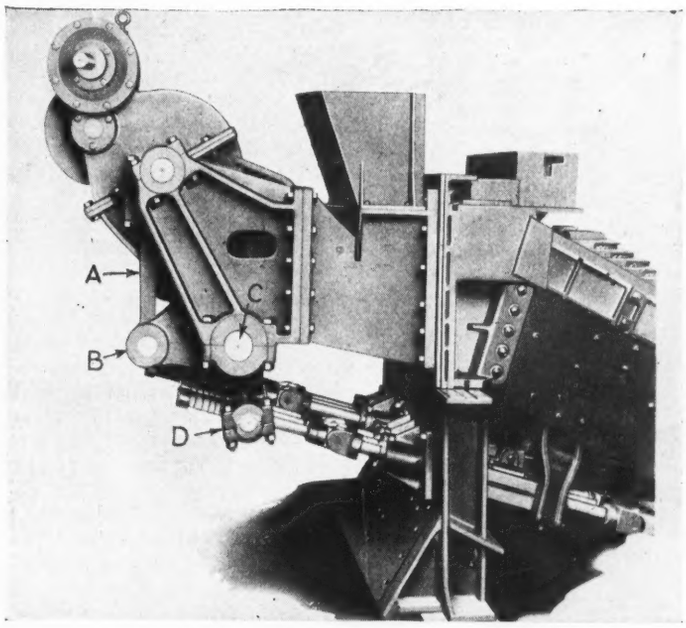
Bridge-wall seal in position and detail of blocks

The new construction offers greater flexibility. The bridge wall is built up, as usual, to a height somewhat below the bottom of the drum, and on top of it, to form the seal, is a coping made up of the two shapes, as shown in the drawing. The larger blocks, resting on top of the bridge wall, have shoulders that pass over the leg of a channel to hold them in place. A depression in the upper face of the lower block forms a bearing into which fits a semicircular half section projecting from the upper block that leans against the drum. Rotation around the axis formed permits the upper block to follow the movement of the drum.

Where it makes contact with the metal the upper block has been rounded to the same radius as the drum, and as the bulk of the weight is on the drum side of the center of rotation, contact will be maintained with the drum. As will be apparent from the detail of the blocks, each block is made with an offset to give adequate seal between them when in position.

New "Straight-Line" Drive for Underfeed Stokers

A NEW drive designated "Straight-Line" for Taylor underfeed stokers has been developed by the American Engineering Company, Philadelphia, Pa. This mechanism gets its name from the fact that it is designed to eliminate angular thrust on the coal-feeding rams and distributing pushers of the stoker. The new drive, it is claimed, greatly reduces the wear on the ram, increasing the life of the mechanism and reducing maintenance cost, this being especially desirable in the large, high-capacity stokers.



Assembly of "straight-line" stoker drive

The coal-feeding ram is driven off the crankshaft by means of a connecting rod *A* which actuates a three-point steel bell-crank lever *B* mounted on a jackshaft *C*. The ram is connected to an arm of the bell crank by a short connecting rod which imparts nearly a horizontal force, eliminating the vertical component of the force produced by the connecting rod on the ram with the old form of drive. This straight horizontal thrust tends to insure even wearing of the ram.

The other arm of the bell crank is a forked lever *D* which operates the distributing ram by means of rods which are brought out at a convenient point at the front of the stoker. On these rods are placed horseshoe collars for adjusting the movement or length of stroke of the distributing ram.

For long stokers, where individual control of each pusher is required from the front of the stoker, additional rods are brought out at the front under the three rods shown on the illustration. The outer and inner extreme collars are fastened to the rods by shearing pins which shear in case of obstruction on either the outward or the inward movement of the rods. Bronze bushings are used in the bearing surfaces and removable cast-iron liners are used in the ram boxes.

At the points where the rods connected with the fuel-distributing rams enter the windbox, airtight gland seals are used to prevent the escape of hot air into the boiler room. The rods are supported at these points by cast-iron guide bearings which also form packing boxes for sealing the windbox.

FROM AMONG THE READERS'

Conducted By L. H. Morrison

CIRCULATION IN A HORIZONTAL-TUBULAR BOILER.—*I have seen the statement that the water circulation in a horizontal-tubular boiler is from front to rear along the top, diameter, the back head and the front along the belly of the boiler. Is this correct?*

M. D. B.

No. The water circulation in a horizontal-tubular boiler has a path in the shape of a figure 8, laid horizontally. Circulation is down the back, then diagonally up to the front head, down the front head and diagonally upward to the rear head.

RECLAIMING CRANKCASE OIL.—*Is it possible to recover the lubricating oil used in the crankcase of our oil engine so that the oil is as good as new?*

B. H. E.

There are several centrifugal and gravity purifiers on the market that will remove all the dirt and grit from the oil. The color will not be the same as new oil, owing to the existence of collodial carbon particles and to oxidation. If the original color is desired, a chemical treatment should be carried on in conjunction with either a centrifuge or filter.

WE ARE USING A VERTICAL BOILER TO SUPPLY STEAM TO SEVERAL STEAM HOISTS.—*The fusible plugs do not last longer than an hour or so. The water level is up above the plug. What is a reasonable explanation?*

M. A. S.

You are probably forcing this boiler, and assuming that the fusible plug is in one of the outer tubes, the end projecting into the tube is so highly heated by the flames rushing up the tube that the other end of the plug cannot transfer this heat to the water fast enough to keep it from melting. As a makeshift cut off the end of the plug so that it does not project into the path of the flame. Better still, get a larger boiler.

PREPARING SULPHUR STICKS AND CANDLES—*How are sulphur sticks and sulphur candles prepared for locating leaks in a refrigerating system?*

P. G. M.

Melt the sulphur by placing it in a flat-bottomed can or pan heated to about 250 deg. F. Sufficient heat usually may be obtained by placing the vessel in direct contact with a hot steam pipe or engine steam-chest cover, or in a boiler uptake. If the melting is done over a fire or flame, the vessel should be supported on an iron plate to prevent overheating and ignition of the sulphur.

For making sulphur sticks, twist together three or four strands of candle wick. Cut it up into lengths about twelve inches long, dip these into the molten sulphur for a few minutes and withdraw to cool in form of a rough candle. If candle wick is not at hand, very good sulphur sticks can be made by dipping splints of soft wood into the molten sulphur.

Better forms of candles are made in molds. A candle mold is readily improvised by rolling sheet asbestos into tubes that have their lower ends packed in fireclay and with the lampwick stretched through the tubes. The tubes are filled with molten sulphur. When the sulphur has cooled, the candles are in convenient form for use with or without the asbestos covering.

CAPACITY OF AN AIR COMPRESSOR.—*We have a double-acting single-cylinder air compressor turning at 50 r.p.m.; the bore is 64 in. and the stroke is 48 in. What is the capacity?*

D. J. D.

The capacity of an air compressor is spoken of in terms of the cubic feet of air at atmosphere pressure drawn into the cylinder and discharged into the delivery line.

The amount of air drawn in is the total piston displacement, less the volume of air resulting from the expansion of the air in the clearance space when the piston completes its delivery strokes. The amount delivered is this net suction volume less the leakage. In a compressor of this size, air of a volume equal to about 85 per cent of the piston displacement is drawn in, compressed and actually delivered.

The piston displacement for one stroke equals piston cross-section $\times$ piston stroke; set in a formula this becomes

$$P.D. = 0.7854 \times D^2 \times S$$

where D is the piston diameter and S the stroke. Inserting the correct values, we have

$$\left(P.D. = 0.7854 \times \left(\frac{64}{12}\right)^2 \times \frac{48}{12}\right.$$

$$= 89.36 \text{ cu.ft.}$$

With a volumetric efficiency of 85 per cent the net volume per stroke is 89.36 $\times$ 0.85 = 7,595 cu.ft. With a speed of 50 revolutions, or 100 strokes per min, the capacity in free air per minute is 759.5 cubic feet.

METERING EXHAUST STEAM.—*We are using the exhaust steam from three engines in processing and are metering the supply to each department. We find that the sum of the readings of the individual meters is 50 per cent greater than the feed-water meter reading. The meters have been rechecked by the maker and found accurate within 5 per cent. What is the trouble?*

P. C.

WITHOUT a diagram showing the position of the meters relative to the engines, it is, of course, impossible to state with finality the cause of this error. However, the pulsations set up in the exhaust line by the periodic inrush of steam will often cause a greater pressure differential across an orifice than the actual steam flow justifies. Consequently, the meter will read high. To discover if this trouble exists, close off one of the lines beyond its meter, so that no flow exists and note if the meter shows a reading. If so, the pulsations are being felt. It may be difficult to place the meters to avoid this trouble altogether.

TROUBLE FROM LONG PUMP SUCTION PIPE—*Trouble is experienced in operating a 6x7x12-in. light service pump on account of leakage in the 4-in. suction pipe, which is 1,300 ft. long. The suction pipe is buried 4 ft. below the surface of the ground. What would be the best way to locate the leak?*

S. T.

A tight suction pipe of the length stated is likely to become airbound in a short time from liberation of air out of the water during the great length of time the water is traversing the pipe while under less than atmospheric pressure, and that trouble is commonly mistaken for a leak or solid stoppage of a long suction pipe.

Before assuming that a leak has developed, it would be well to stop the entrance end of the pipe and use water from a tank under pressure or employ the pump for testing whether the pipe is tight against pressure. If it is found to be pressure-tight, the air "plugs," which usually consist of accumulations of air bubbles, will have to be pushed out of the pipe by forcing water through it.

If the pipe is found to have a leak, its location can be determined by making pressure tests of different sections, beginning, for instance, at the middle of its length and testing each half, thus narrowing down the search to a small section of length that contains the leak. In most soils where the leak is considerable, its location will become revealed on the surface of the ground by keeping the pipe under water pressure for 12 to 24 hours.

PROBLEMS

ANSWERS

from Our Readers

THE QUESTION

USING a treated boiler-feed water, what should be the per cent yearly increase in steam consumption of a 1,000-kw. turbine, the boiler pressure being 300 lb. with 150 deg. superheat?

C. M.

A TURBINE of this size, well designed and constructed, when operated under the conditions stated should be capable of continuous service for a few years without showing more than 2 or 3 per cent increase in steam consumption per year.

Two of the chief causes of blade deterioration are erosion and corrosion. These have been eliminated by the use of high-temperature steam and feed-water treatment.

One important factor still remains—that of idle time. Many blade troubles are born during the time the unit is out of service. The presence of moisture in the casing during the shutdown, will start blade corrosion, and when once started, this develops very rapidly.

Sudden and frequent charges of temperature when putting the unit into or out of service will tend to start small fractures on the blade edges. Improperly drained, erosion will set in when the turbine is started up.

All these factors are likely to contribute more to the rapid deterioration of the unit than will the actual operation. If these conditions cannot be avoided, then the percentage increase in steam consumption will be much higher, but otherwise 3 per cent increase in steam consumption is sufficient to allow per year under intelligent care.

GEORGE MCNALLY.

Kearny, N. J.

THE question does not indicate whether it deals with the change in turbine water rate due to blade erosion or that due to changes in superheat occasioned by a decrease in boiler-like scale. I am assuming that the former is the angle of approach desired by the questioner.

From time to time certain of the larger public-utility companies have made tests to determine the turbine efficiency drop due to erosion. It has been found that the average annual increase over the installation-test steam consumption varied from 0.13 to 1.77 per cent.

Obviously, the erosion rate depends upon the type of boiler water, or more directly upon the steam characteristics. If steam, either saturated or superheated, carries slugs of water, the blading will cut rapidly, and of course this is reflected in the turbine steam rate. Consequently, steam quality is as important as the character of the feed water. In addition, a boiler feed water may be treated yet still contain acids in solution that may pass over as a gas along with the steam, or there may be considerable air in the feed water; this will set up corrosion in the blading.

Turning to a chemically inert feed, such as distilled water, it must be considered that even here blade erosion and increased steam consumption could occur, if other things did not upset the conditions.

Blades do not last forever, and with the usual turbine, the blades must be renewed owing to the mechanical failure, before erosion or corrosion has become pronounced enough to be indicated by an observable increased rate.

I think the *Power* reader who put the inquiry is being worried by an imaginary and improbable danger. Other ever-changing details of a power plant will produce variations in the coal bill long before the turbine becomes inefficient. Poor baffling, boiler-setting cracks and other boiler-room details are the things to worry over.

Philadelphia, Pa. JOHN J. JONES.

THE installation of a water-treating plant would probably increase the water rate of the turbine, due to the decrease in superheat, which, in case of the convection type of superheater, follows a reduction in the thickness of the scale on the boiler-tube walls.

In the question there is no information given as to the size or type of the boilers used nor of their condition before installation of the water-treating plant. But my experience is that the decrease in superheat will probably be at least 30 deg. F., resulting in an increase of about 2½ per cent in the water rate of the turbines.

Scale $\frac{1}{32}$ in. thick on the boiler tubes increased the superheat from 200 to 230 deg. on a superheater installed between the first and second passes of a vertically baffled cross-drum boiler having the entire length of the first two rows of boiler tubes exposed to radiation from the furnace. This increase in superheat occurred when the boilers were operating at about 220 per cent of rating. The increase in the flue-gas temperature leaving the boiler was so small that it could not be definitely measured. This indicates that the increased superheat was principally due to the decrease in the rate of heat transfer in the tubes exposed to radiation from the furnace.

Cincinnati, Ohio. EVERETT JENNE.

THERE can be no definite answer to this question as different boiler-feed treatments and different waters do not have the same effect on the turbine blading. In some cases solids are carried over with the steam and are deposited on the turbine blading, sometimes on the first-stage and sometimes on the last-stage blading, depending upon the character of the solids. Of course, the increase in steam consumption will depend upon how fast these solids deposit on the blading.

Excessively wet steam in the last stages causes blade erosion, which will also increase the turbine steam rate. It is generally conceded that the moisture in the turbine exhaust should not exceed 11 per cent.

Corrosion is also sometimes encountered owing to the presence of oxygen and carbon dioxide in the steam. The pitting and wearing away of the blades due to this action also increases the turbine steam consumption.

Because of the many variables and of the effect of local conditions it is evident that no general statement can be made regarding the effect of feed-water treatment on turbine steam consumption.

R. B. BROCKNER.

Detroit, Mich.

A Question For Our Readers

CAN a 10x12-in. steam engine be run on oil at 100 lb. gage? What adjustments are needed?

P. M.

Suitable answers from readers will be paid for and published in the July 30 issue.

Water Tube Boiler Explodes
at Crossett, Arkansas

ONE fatality and property damage estimated at $150,000 were the results of an explosion in the plant of the Crossett Lumber Company, of Crossett, Ark., Thursday, May 30. The damage created is shown in Fig. 1. Before proceeding with the account of the accident, it will be of interest to know something of the plant and the operating conditions. In addition to supplying the sawmills, planing mills and other properties of the lumber company, the plant furnished all the water, electric power and steam heat for the town of Crossett, the steam heating lines being carried by overhead construction throughout the town.

In 1922 the Crossett mills were served by 24 fire-tube boilers located in six separate structures close to the engines they drove. In addition, a 125-kw. turbine generator supplied light to the mills and the town. As much of this equipment had deteriorated and had to be replaced, the decision was made to build a central power plant and electrify the mills. This new plant went into operation in 1923. The general layout is shown in the transverse section, Fig. 2, and in the plan of the power plant, Fig. 3. The equipment consisted of six water-tube boilers of the two-drum bent-tube type, each containing 5,009 sq.ft. of steam-making surface. They were built to operate at a pressure of 225-lb. gage. Each boiler was suspended from cradle supports at both ends of the upper drum, the cradles being carried by cross-beams tieing in with vertical columns at the sides of the setting. The lower drum hung free in the setting, suspended by the tubes.

As is customary in a plant of this kind, the fuel was sawdust, shavings and hogged fuel from the mills, and it was stored in the fuel house (shown at the left in Fig. 2). Electrical energy was supplied by four turbine-generator condensing units having an aggregate capacity of 5,250 kw. This equipment was housed in a structural steel building with brick walls, the boiler room having a twelve-foot louvered monitor running the full length of the roof, which was of corrugated steel.

Water for condensing and for boiler makeup was taken from a series of ponds. This water contained, on the average, from two to four grains of scale-forming matter per gallon and the saline condition is indicated by a content of sodium chloride ranging from 1½ to 5½ grains per gallon. During the hot months there was a scarcity of water, so that the supply to the plant contained a good deal of mud and vegetable matter

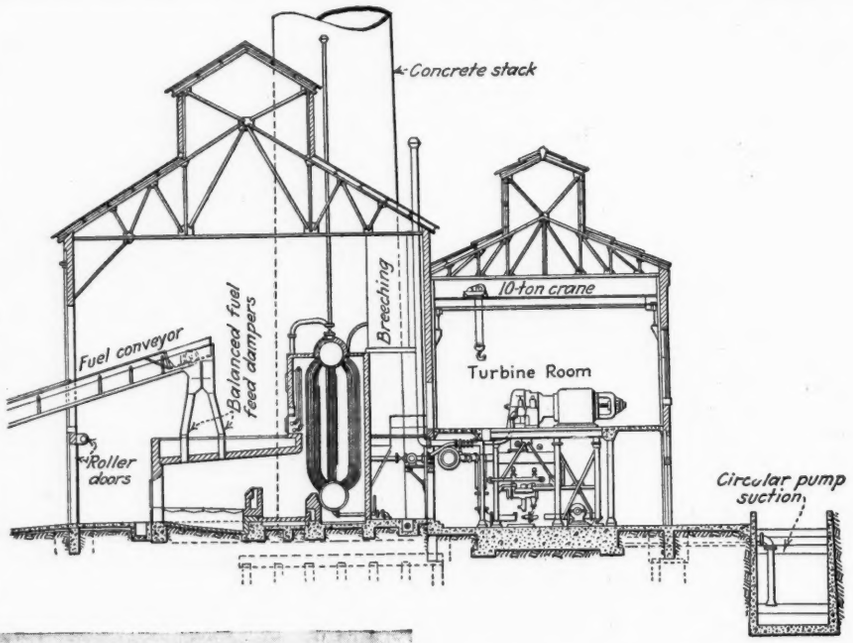


Fig. 2—Transverse section through power plant and fuel storage house

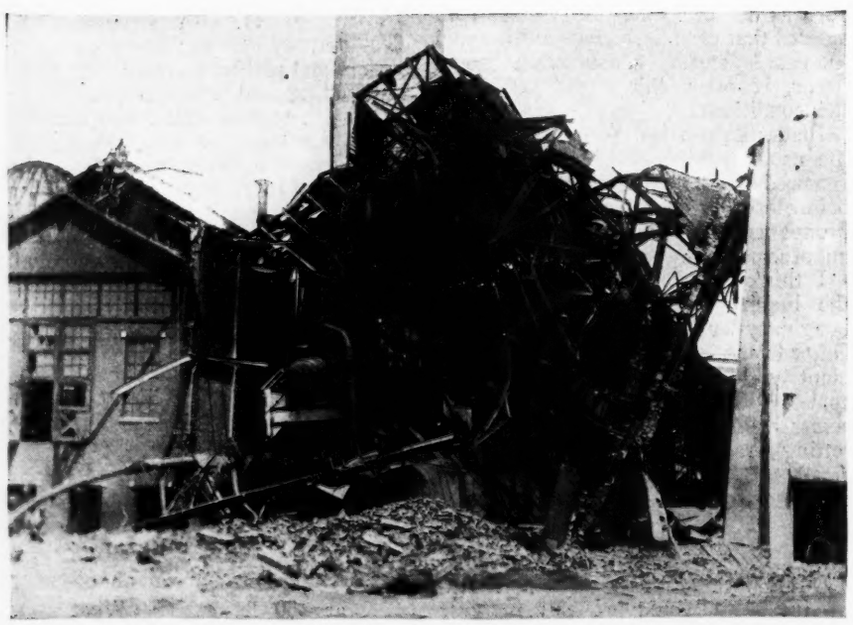


Fig. 1—Aftermath of boiler explosion at Crossett Lumber Company plant

For the first two years this feed water was not treated. It was pumped directly from the ponds into a 125,000-gal. overhead service tank and the makeup for boiler feeding was taken from the general service line from this tank. With feed of this character the boilers scaled badly and dirty steam was carried over to the turbine room.

To relieve these conditions, a deconcentrator system accompanied by lime and soda treatment was installed in 1925. Since that time the concentration in the boiler and the condition of the feed water has been watched carefully by the plant organization. These provisions seemed to relieve the trouble, as scale formation was stopped and the difficulties encountered from feeding

dirty steam to the turbines was eliminated.

The practice had been to maintain five boilers in continuous operation. Although the mills operated days only, at night there was the kiln load and the lighting of the town. Suddenly, on the evening of the explosion, with no previous indication of any kind, boiler No. 6 let go in the longitudinal seam of the lower drum, demolishing fully one-half of the boiler house. The seam opened up from end to end, both heads blew out and the upper drum and tubes rose 100 ft. in the air to land near the side of the fuel storage house, 30 ft. from the setting. This drum may be seen resting in the débris at the right of the photograph. No. 5 boiler was knocked out of its setting and so badly twisted and damaged as to have no salvage value. The upper drum, resting in the cradles, may be seen at the left of the photograph. No. 4 boiler was also damaged, but to a smaller extent. There was no explosion in either of these boilers, as the steam pressure had been relieved by the initial blast. The other three boilers were not hurt in any way and are to be continued in operation temporarily to supply steam to the kilns at a pressure of about 80 lb. A locomotive was hooked up for emergency operation in the mills, and arrangements have been made to purchase current until the boiler plant has been restored. No injury was done to the turbine room or to the fuel house.

Plans are under way to install three new boilers, which will be of the same make as the damaged boilers, but of the three-drum type. As there was need for greater capacity, each of these boilers will contain 8,130 sq.ft. of surface. Boilers Nos. 1, 2 and 3 will be kept, but to avoid any possibility of a similar accident, the drums will be replaced.

Early examination of the remains of boiler No. 6 showed no evidence of scale, no cracking and no visible indication of deterioration of any kind. Another point of interest is that the drums were inside calked.

As to the cause of the explosion two theories have been advanced. One points to embrittlement, and the other to fatigue of the metal along the longitudinal seams. With the lower drum suspended as indicated, there would be a tendency for it to get out of round by the sides flattening slightly owing to the weight of the contents. Owing to the steam pressure, the flattened circle would tend to round. With changes in pressure there would be a breathing action that would fatigue the metal along the longitudinal seam and eventually might weaken it to the point of rupture.

The foregoing is, of course, pure guesswork. It may be stated that independent investigations are now being made and as soon as conclusions have been reached the results will be available for publication.

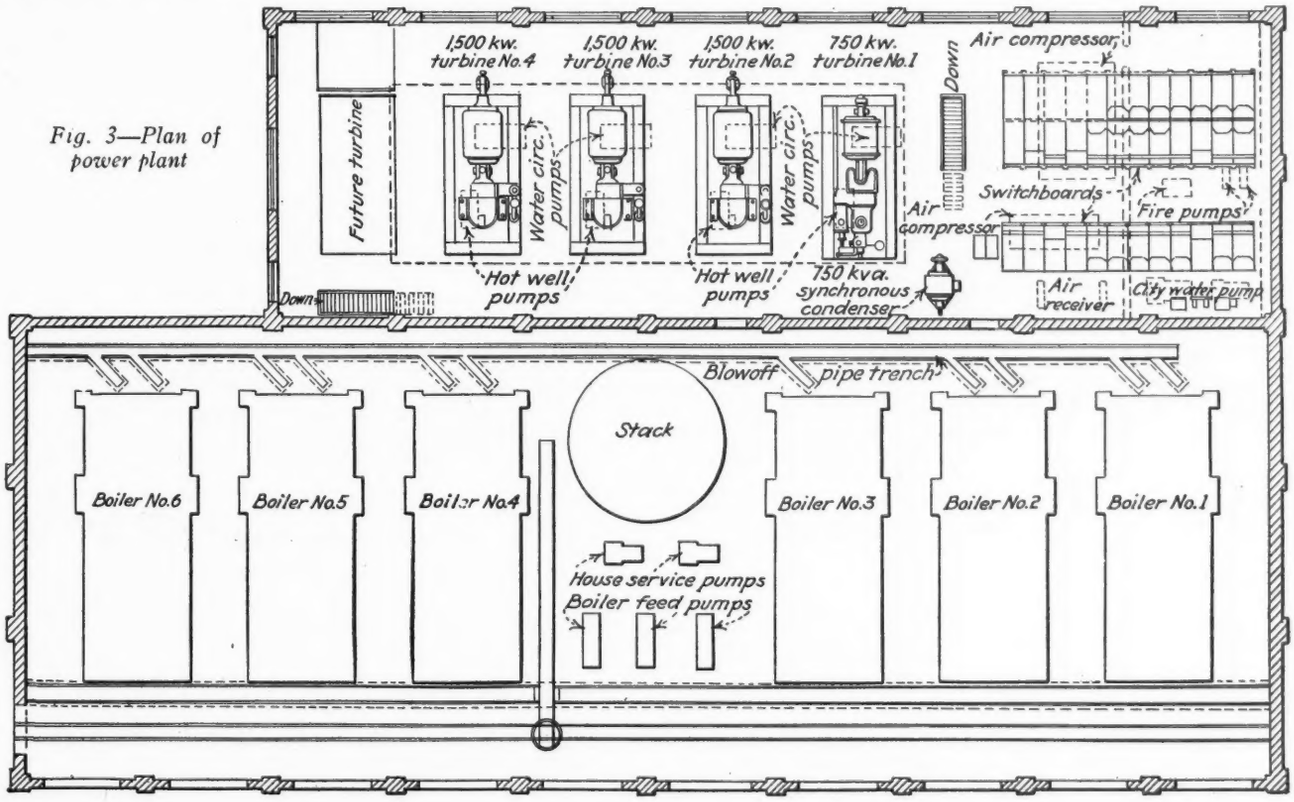


Fig. 3—Plan of power plant

A new specification for Grades A and B marine boiler steel plates, AMSC 62, developed by the American Marine Standards Committee in co-operation with the American Society for Testing Materials, has been issued by the United States Department of Commerce, supplementing its previous paper on the same subject, AMSC 61. It outlines all the requirements that must be met by the manufacturers of marine boiler steel plates.

Crankcase Oil Reclaimed in Economy Drive by Railroads

RECLAMATION of gasoline crankcase oils is one of the recent economies that have been put into effect by numerous railroads, according to a report submitted by the reclamation committee at the Tenth Annual Convention of the Purchase and Stores Division held in San Francisco.

"The contamination and dilution of such oils," said the report, "results in serious waste and expense through the scrapping of the used oil, and needless wear and tear of engines. Some means permitting more frequent changing of the oil without an increase in lubrication costs has long been needed. Such a process serves the ends both of better lubrication and of conservation.

"Through processes now being used, reclaimed oil is available for use at a fraction of the cost of new oil. The saving thus effected not only makes possible more frequent changes of oil with resultant decrease in maintenance costs, but enables the purchaser to secure the highest grade of oil at a lower ultimate cost. Through the method of reclaiming crankcase drainings, reclaimed oil has been used exclusively in the operation of a number of gas-electric rail cars, with apparently just as good results as with new oil."

The reclamation of crankcase oil is only one of many such savings that have been developed, according to the report. Means of reclaiming packing and oil used for journal boxes have been devised.

Boiler Inspectors Meet in Detroit

FROM June 18 to 20 at the Fort Shelby Hotel, Detroit, the National Board of Boiler and Pressure Vessel Inspectors held its seventh annual meeting. A registration of about one hundred was considered good representation for this body. A full program had been arranged. Four sessions during Tuesday and Wednesday morning were given over to papers and addresses covering topics of current interest to the inspectors. Wednesday afternoon was devoted to an inspection of the Ford airport and the Ford museum the evening being given over to the committees on design and questions. Thursday an executive session of the national board was held, when representatives from the A.S.M.E. boiler code committee, the American Boiler Manufacturers Association and the Uniform Boiler Law Society sat in to assist in helping to solve some of the problems pressing for solution.

At the opening session William Kent, in behalf of Mayor Lodge, welcomed the visitors to the city. Through Mr. Mills, John F. Bischof, Commissioner of Buildings and Safety Engineer, for Detroit, outlined some of the things the boiler inspector must look for. William T. Blake, Director of Industrial Relations for Ohio, was impressed with the preamble of the organization, stating that "the National Board of Boiler and Pressure Vessel Inspectors is organized for the purpose of promoting greater safety to life and property, by securing concerted action and maintaining uniformity in the construction, installation and inspection of steam boilers and other pressure vessels and their appurtenances and to secure interchangeability between political subdivisions of the United States." His address was interlarded with statistics giving the direct and indirect costs of industrial accidents to show why Ohio prefers safety to compensation and, incidentally, to convince the inspectors of the value of their work.

C. D. Thomas, chairman, spoke of the trend toward co-operation. Minor differences would soon be swept away as every delegate was working for uniform interpretation and uniform application of the code. It is important that the work broaden out into non-code territory, so that states and cities not now represented might increase their knowledge of the code by participating in the annual meeting. The chairman recommended a standing committee to pass on new designs and appliances. He felt that the time had come to remove some of the restrictions on small welded pressure vessels, providing that the manufacturers would comply with the rules and so stamp their product.

C. O. Myers, the secretary-treasurer, reported that California and a number of cities had adopted the boiler code during the last year and that Ohio had adopted an unfired pressure-vessel code. He gave the number of code boilers registered during the last three years and spoke of a net decrease in the assets of the organization from two years ago. In his opinion, a research committee should be placed on the board, and as welding is making great progress he believes that the organization should be prepared to control it.

L. C. Peal, the Board's statistician and boiler inspector of Nashville, Tenn., reported a total of 276,830 insured boilers and 251,793 boilers in Code territory, leaving a balance of 25,037 insured boilers in non-code territory. Accidents reported were 230, with a fatality list of 29, injured 45, and property damage $312,440. These accidents were divided according to boiler types as follows: Water-tube, 26; horizontal-tubular, 7; vertical-tubular, 6; firebox, 7; cast-iron sectional, 170; unfired pressure vessels, 14. Separation of these accidents into code and non-code was enlightening.

	Code Boilers	Non-Code Boilers
Accidents and failures	41	175
Fatalities	1	9
Injured	0	20
Property damage	$23,158	$289,282

	Code Unfired Pressure Vessels	Non-Code Unfired Pressure Vessels
Accidents	2	12
Fatalities	0	19
Injured	0	25

Cast-iron boiler accidents were 170, with a loss of $52,105, while only three failures were reported on steel boilers, occasioning a loss of $995. Reports of specific failures and the causes followed, to show the need of inspection in non-code territory.

Charles E. Gorton, chairman of the Uniform Boiler Law Society, indicated the trend toward uniformity by stating that there had been only three or four instances in the last year of states or cities not living up to the code.

Louis A. Duni, president of the Board of Mechanical Engineers of Los Angeles, mentioned the adoption of the code in his state and the restoration of the inspection staff. He referred to inspectors in general as men of character and ability who could say, "No", and, by performing their duty as they saw it, promote safety and soundness.

Speaking in behalf of the American Boiler Manufacturers Association, E. R. Fish emphasized the importance of working and pulling together towards the goal of 100 per cent accident prevention. Unfortunately, there was a difference of opinion on welding, on the type of weld and the qualifications of the welder. He believed that one of the inspector's duties should be to see welding done correctly.

Prof. T. M. Jasper, of the A. O. Smith Corporation, spoke in the interests of uniform rules and regulations throughout the country for the protection of the maker and user of pressure vessels and everybody concerned. His slogan was, "The more inspection the greater the safety."

At the afternoon session Charles J. McCabe, smoke inspector, of Detroit, reviewed the activities of his department, which between 1927 and 1928 had succeeded in effecting a 50 per cent reduction in solids in the air. The figures were respectively 110 tons and 60 tons, the soot content averaging about 33 per cent of these totals.

P. R. Hawthorne, of the Petroleum Iron Works Company, pictured the fluid fusion-welding process, the shop built to do the work (in which electrodes were used up to one inch diameter that would deposit metal at the rate of 100 lb. per hour) and many examples of work done. All joints were butt-welded and every weld annealed. By this electric arc process metal up to twelve inches thick could be welded, so that the company was in a position to build boiler drums for any pressure.

C. W. Obert stated that in the future it was the intent of the boiler code committee to turn over much of the work to the national board and function principally as a consulting body. He reviewed the numerous things that had been considered by the board during the last year, such as the revision in the dished head, nozzle and threaded connections, use of additional safety valves to take care of water walls, new flange and fittings standards, the new scheme of code stamping, provisions for the welding of water legs, shutoff valve between boiler and superheater, cold bending of plates, alloy steel plates and the proposed compromise to 4 lb. per sq.ft. of heating surface as the basis for computing safety-valve-releasing capacity for fire-tube boilers operating above or below 100 lb. From July 1 revisions were to be sent out to the field semiannually and the thought was to make them compulsory six months later. The code committee was considering a carbonate-sulphate ratio of 2 for pressures below 150 lb. and variable ratios between 150 and 600 lb. Mention of caustic embrittlement and cold flanging of boiler plate caused prolonged discussion on these subjects.

Following an informal dinner Tuesday evening there was a series of five-minute talks. H. H. Mills emphasized the importance of the hydro-static test in boiler checking. T. P. Hetu enumerated the essentials in shop testing and the results when the inspection was not carefully made. Prof. T. M. Jasper outlined the possibilities of a welded vessel from the standpoint of shape and design, materials and fabrication. The right kind of welding permitted use of better designs and better metals. Eventually, the welded joint would displace all other methods of fabrication. Severe testing was the most practical way to determine the strength and to eliminate prejudice. It

had been found repeatedly that these severe tests did not reduce the strength of the vessel.

Allan A. Grant enumerated the causes of bulges in shells and drums of steam boilers and gave some indication as to what should be done to them, depending upon the location, the heat to which they were subjected, the area of the bulge and the deposit in the bulge. Thomas H. Quiery discussed the troubles and griefs associated with the second-hand boiler. It was his suggestion that second-hand boilers should not be inspected and the responsibility for their operation assumed unless their full histories were available. Once these boilers have been inspected, the details should be on record with the national board.

Wesley McLean referred to the wider use of pressure vessels and to the ever-increasing internal pressures that through faulty design and improper use might result in disastrous explosions. These vessels should be protected by safety valves, reducing valves or other means and should be subjected to inspection equal to that given boilers. Otis L. Schooley outlined a plan making it possible for boiler inspectors to become associate members of the national board. To promote exchange of experience, locals affiliated with the national board might be organized and a paper published making inspection reports of unusual interest available to all.

At the Wednesday session two comprehensive papers were presented by L. D. Betz, chemical engineer, and G. C. Reinhard, chief chemist of Feedwaters, Inc., on the conditioning of boiler feed water through the application of colloidal gels. The nature of colloids and their formation into gels were explained and full details given as to how they can be used to prevent scale formation, dissolve scale that has been formed, eliminate corrosion and, in fact, overcome all the objectionable features in boiler water.

"Embrittlement in Steam Boilers," by Frederick G. Straub, research chemical engineer, University of Illinois, was a paper of intense interest to the inspectors. To give an idea of the subject, the author took the specific case of a boiler explosion that had resulted from embrittlement, and he went through the procedure followed to determine the cause, considering these five factors: Design of boiler, workmanship, quality of steel, type of crack, and the water used in the plant.

Some of his conclusions were to the effect that high temperature differentials over the joint had not been found to have much influence on cracking, the only result being to stress the steel slightly beyond the yield point. Embrittlement is caused by the action of caustic soda on stressed steel. Methods of prevention are proper treatment of the water, removal of the highly stressed areas, inside calking of the joint, and use of steel not susceptible to caustic attack. Incidentally, such a steel has not been found.

In a lengthy discussion taking up specific failures J. C. McCabe, of Detroit, came to the following conclusions: The asssumption that the A.S.M.E. formula P-180 gives a factor of safety of 5 is not true. It is only an average. The loads are concentrated at the rivets. In the driving of the rivets, the holes are invariably strained beyond the yield point under the whole head area. This throws the adjacent portion of the plate into tension and reduces the ability of the structure to carry a load safely. A condition is obtained where both surfaces are elongated under the rivet; a tension is set up longitudinally near rivet holes and then, after calking, an added stress is set up from the calking on the inner surface of the calked plate and an unloading of the external surface when it is put in compression.

The magnitude and effect of temperature stresses is seldom appreciated. These stresses may amount to 195 lb. per sq.in. per degree of difference Fahrenheit. With a temperature difference inside and out of 80 deg., a stress exceeding 15,000 lb. per sq.in. may be induced. Mr. McCabe thought that the term embrittlement was a misnomer, as on test the metal under the surface cracks proved ductile. It had not embrittled.

Briefly, where cracked plates are found, the prime cause is in the design and workmanship.

Caustic soda will contribute to and hasten the cracking of overloaded metal. The presence of the caustics elevates the transmission temperature seriously and might precipitate failure in a joint already at a balance. In long joints the plates are often loaded transversely as rolled. When caustic or other precipitate is found between the plates of a joint, it is clear evidence of the existence of the possible conditions previously referred to.

It is not good engineering to design a structure wherein a most important part is strained to the yield point. The inference is that riveted joints must go, and it may be stated as the opinion of Mr. McCabe that the use of welded joints is inevitable.

All officers were re-elected, as follows: C. D. Thomas, of Oregon, chairman; W. H. Furman, of New York, vice-chairman; C. O. Myers, of Ohio, secretary-treasurer; L. C. Peal, of Nashville, Tenn., statistician.

A change in the constitution was effected, making the office of secretary-treasurer appointive by the executive board rather than elective.

Engineering Research in Germany

By A. A. POTTER

Dean of the Schools of Engineering and Director of Engineering Experiment Station, Purdue University

MR. W. E. WICKENDEN, director of investigations for the Society for the Promotion of Engineering Education and president-elect of the Case School of Applied Science, in a paper which he presented before the American Association for the Advancement of Science on Dec. 29, 1928 (*Science*, March 22, 1929), gives a clear picture of engineering research in Europe. He states that "Germany is the land of technical research par excellence." The policy of German industry is to encourage creative work in engineering colleges by establishing special research institutes under the direction of famous professors. Examples of this are the metallurgical institute at Aachen, the laboratory of hydraulic construction at Karlsruhe, the automotive institute at Charlottenburg, the research center on piston engines at Dresden, the heat physics laboratory at Munich, and similar centers where industry is placing the ablest researchers as professors and giving them resources for creative work rather than drawing them away to industrial establishments.

J. M. Spitzglass in a paper prepared for the A.S.M.E. main research committee on "Research in Germany" (*Mechanical Engineering*, April, 1929) makes the following statement:

Society or public research is more co-operative in Germany than in the U. S. of A., while individual or private research is more secret."

Mr. Spitzglass finds "Americanization tendencies" in Germany and states that the American is both envied and admired.

The outstanding feature of public or society research in Germany is the correlation of its activities through the main German engineering society, the Verein Deutscher Ingenieure, in Berlin. This society subsidizes and controls practically all the research activities of the engineering profession, and all public investigations of a scientific character are cleared through it. This society has three main groups of committees, scientific, technical and professional. The scientific committees are responsible for heat research, vibrations and similar fundamental problems. The technical committees are concerned with such problems as steam boilers, flow measurements and welding. The professional committees deal with steam power plants, steam turbines, gas engines and gas producers, water motors, pumps and cooling towers. Mr. Spitzglass gives in his paper an outline of the projects now being carried on under these committees. About $50,000 a year is being set aside for research under the auspices of the German engineering society.

[*The article in the August 6 issue will deal with "Thermal Research."*—EDITOR]

Waterworks Engineers Discuss Station Equipment and Feedwater

THE American Water Works Association, which held its annual convention in Toronto, Canada, last week, devoted two sessions to subjects of particular interest to power engineers; one was the "boiler feed water," and the other "the selection of pumping station equipment."

Sheppard T. Powell, consulting chemical engineer, of Baltimore, reviewed the importance of feed-water treatment in the light of radical changes in boiler practice during the last ten years. One of the important developments has been the combination of various forms of water purification processes. The combination of chemical and zeolite softening, additions of coagulents with softening reagents, continuous blowdown systems and steam purifiers have revolutionized feed-water treatment.

No new chemicals of importance have been produced for water conditioning, but there has been a marked increase in the use of some softening reagents. This is particularly so in the case of phosphates and sodium aluminate. Investigations to determine methods of treatment to inhibit embrittlement of boiler steel have been responsible for the increased use of phosphate. Both di- and trisodium phosphate have been used and mono-phosphate is now being offered.

Inhibition of corrosion of boilers, heaters and condensers by electrolytic methods has also continued to attract attention and a number of successful installations have been made lately. Research is now being conducted at two universities to determine the actual cause of this phenomenon.

Dissociation of Water in Superheaters

Many high-pressure boilers operate on untreated distilled water, and in such cases the corrosiveness of pure water becomes a problem of primary importance, for it is well known that pure water will dissolve iron, and when dissolved oxygen is absent a galvanic type of corrosion will occur.

During the initial survey of feedwater conditions in a new power plant of the Detroit Edison Company, which is to operate with untreated distilled water, experiments were made to detertmine the changes that water and steam undergo from the economizer through the superheater. The presence of small amounts of hydrogen in both the saturated and the superheated steam indicated the probable dissociation of the steam in contact with steel at high temperatures. This led to further tests the results of which were reported in a paper by C. H. Fellows, of the Research Department of the Detroit Edison Company.

Tests were made at 420 lb. per sq.in. and with temperatures from 1,000 to 1,400 deg. F. on low-carbon steel and chrome-steel tubes, the inside surfaces of the tubes in both cases having first been pickled. The tests showed (1) that the decomposition of the metal increases as the temperature of the surface over which the steam passes is raised; (2) that the rate of decomposition of the metal decreases as the thickness of the oxide formed on the surface increases; (3) that variations of steam pressure within the limits employed did not affect the rate of decomposition of the metal; and (4) that decomposition of the low-carbon steel proceeded much faster than the chrome steel. Furthermore, dissociation increased with a decrease in steam velocity.

The author pointed out that while there was practically no dissociation at metal temperatures such as ordinarily obtained in superheater tubes, secondary combustion might easily produce temperatures sufficient to cause it.

[*A more complete abstract of Mr. Fellows' paper will appear later.*]

In a paper on "Deaëration of Water in Relation to the Character of the Water Supply," J. R. McDermet, of the Elliott Company, pointed out the differences between deactivation and deaëration. The former is the removal of dissolved oxygen by causing the water to lose its rusting properties through attack upon scrap metal in the process of treatment. Deaëration implies the removal of all dissolved atmospheric gases in the water by a vapor-phase equilibrium process in which thee water is in intimate contact with an atmosphere of extremely low atmospheric gas content.

Deactivation is applicable where small quantities of water are to be treated. Because of the slow character of the corroding action in the water and scrap metal the size of the apparatus is prohibitive for large quantities of water. Deaëration, however, is able to handle almost any quantity of water.

Selection of Pumping Equipment

A. P. Pigman discussed the "Selection of Pumping Station Equipment" in which he presented the results of a study of four typical plants based on horsepower. In each of these he compared the annual costs, including fixed charges on investment, fuel and labor, first with steam equipment, then with Deisel engines and finally with purchased energy. In the first series of studies it was assumed that the water is to be pumped only once and that there is a large reservoir in the system so that the load is uniform varying only seasonally. Next, a fluctuating load was selected and finally a case where it was the problem of merely adding new capacity to an existing plant.

As a working basis in these studies the cost of coal was taken as $3 a ton, oil at 6 cents a gallon and electric energy, including demand charges, at one cent per kilowatt-hour.

The general conclusions from these studies was that for a new plant employing a uniform pumpage rate a steam plant generally has a decided advantage, provided it is large enough to justify the installation of turbines of more than 1,500 hp. On the other hand, if the horsepower requirements are less than 300 the electric plant has the advantage. In between these sizes the Diesel plant has a slight advantage, but is closely competitive with steam as the size approaches the upper limit and with electricity as the size approaches the lower limit. It was further found that whether the pumpage is single or double makes very little difference. If the load has wide fluctuations more equipment is necessary to handle the same average load and therefore the low unit investment of the electric plant has a greater advantage than it possesses in the case of the uniform load.

In a paper entitled "Comparative Data on Steam and Electric Pumping Stations," J. F. Laboon, of Pittsburgh, pointed out that where power is available from at least two dependable sources to justify underwriter requirements and reservoir storage is provided motor-driven pumps become desirable. If, however, reservoir or proper storage is not available, thus necessitating pumping directly into the distribution system, motor-driven centrifugal pumps become less efficient and consequently less desirable. This is in contrast to direct-acting steaming pumps which can be governed automatically to maintain pressure requirements at varying outputs without material sacrifice of efficiency. With conditions favorable to the use of motor-driven units the cost of power then becomes a consideration.

Other papers at this session were "Equipment for Electrically-Driven Pumping Stations," by R. L. Baldwin; "Pump Discharge Headers and Pump Piping for Waterworks Stations," by F. G. Cunningham; and the "Selection of Equipment for the Clove Pumping Station of the Staten Island System," by William Flannery.

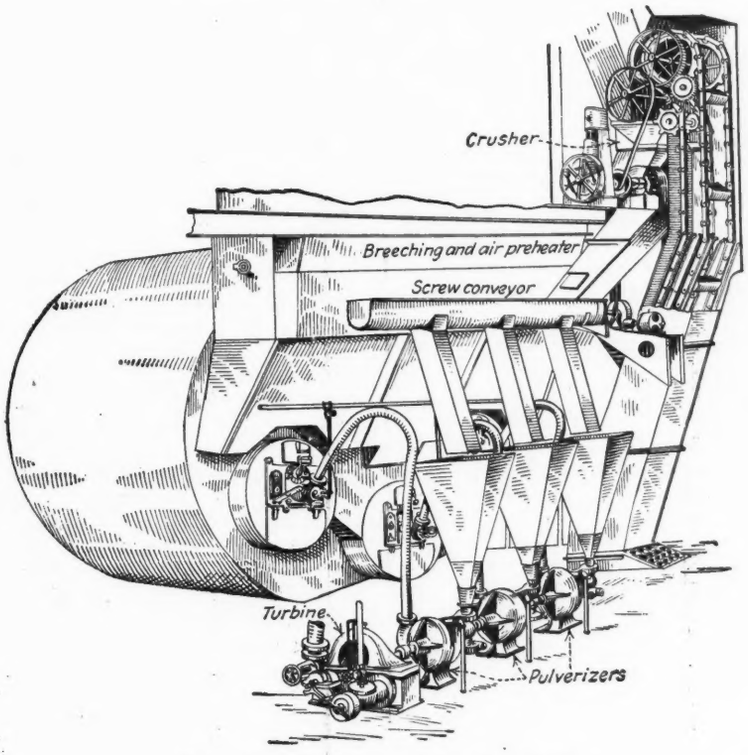
The several papers were discussed at length and there was considerable division of opinion as between the reliability of steam and electrically-driven equipment. The concensus of opinion seemed to be that in certain localities where a dual electricity supply was available, and especially where one of these was underground, that the motor-driven pumps were to be preferred, but where such continuity of service was not assured the steam or Diesel plant was desirable.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING

INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Second Shipping Board Vessel to Burn Pulverized Coal



Pulverized Coal Layout for One Boiler

THE steamship "West Alsek," the second Shipping Board vessel to be fitted for burning pulverized coal, underwent a successful trial trip out of New York Harbor on June 19, in the presence of over a hundred and fifty engineers and steamship men, preparatory to going into regular service.

Like the "Mercer," the "West Alsek" has three single-ended, three-furnace, Scotch marine boilers, but the pulverizing equipment and burners are entirely different from those installed on the former. Each furnace on the "West Alsek" is served by its individual mill. These mills, of Erie City Iron Works design, are arranged in groups of three (one group per boiler) and each group is driven at 3,400 r.p.m. by a steam turbine. Coal from the bunkers on either side passes through a coal crusher and is delivered by an overhead screw conveyor to the chutes leading to the mills. It is planned to install magnetic separators later. All the mills are arranged in line at the back of the firing aisle and the coal is conveyed through flexible pipes to the burners. This arrangement provides ample space in front of each furnace.

The burners are of the turbulent type, of Todd design, and employ pre-heated air. If necessary they can be run on oil.

An idea of the layout can be had from the accompanying sketch representing one boiler unit. In order that an idle boiler will not fill up with fly ash from those in service, the uptakes from each boiler have been kept separate right up to the top of the stack.

The installation was designed for flexibility and maximum efficiency at relatively low rates. Moreover, it gets around the problem of three-way distribution from a single mill which proved so troublesome in the earlier installation on the "Mercer."

New England States Association Holds Annual Convention

THE annual convention of the New England States Association of the National Association of Power Engineers was formally opened at the Armory in Fitchburg, Mass., on Thursday evening, June 20, by U. S. Deputy Thomas H. Clark who introduced Clarence H. Warner, of the local organization as the presiding officer.

The delegates were welcomed to Fitchburg by Mayor Joseph N. Carriere, whose cordial remarks were fitly responded to by President John A. Bakstran of the New England States Association. James H. Walsh, Jr., president of the Chamber of Commerce, welcomed the convention on the part of that institution and was followed by President Clarence T. Corley, of the Fitchburg Association; Past National President Elmer Bassett, and Timothy J. Harrington, vice-president of the Fitchburg Association.

The exercises were held in the large drill shed of the Armory where, under the management of William H. Dennihau, chairman of the committee of arrangements, there had been arranged over sixty attractively decorated booths containing exhibits of power-plant apparatus and supplies.

The first formal session of the delegates was called to order in another room of the Armory, on Friday morning by President Bakstran, the report of the credentials committee showing 67 accredited delegates present. Morning and afternoon sessions were devoted to addresses and reports from officers and committees, an address by T. F. Preston, on the "N.A.P.E. As seen by a New Member," and an interesting discussion on the "Good and Welfare of the Order." A resolution was passed endorsing the candidacy of U. S. Deputy Thomas H. Clark for national vice-president. In his report as chairman of the License Law Committee of Rhode Island, Joseph E. Kelly said that there were in that State about 900 engineers, the same number of firemen, and some 4,000 boilers. National trustee William J. Reynolds, who was to have represented the national president, at the opening exercises on the preceding evening, made some interesting and pertinent remarks.

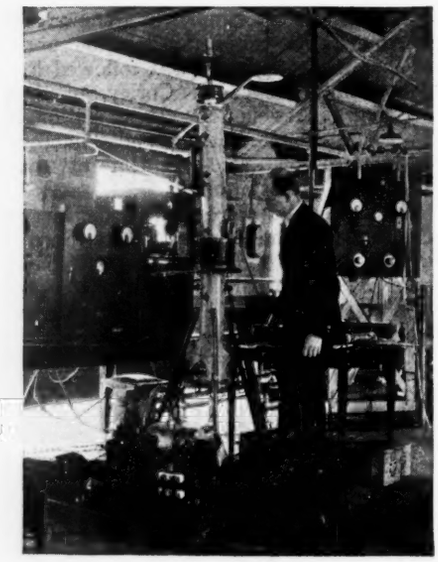
The election resulted in the selection of the following officers for the ensuing year: president, Arthur Ford, superintendent of armories for the State of Massachusetts, advanced from vice-president; vice-president, Charles E. McLean, of Lowell; secretary, Karl B. Powers of Cambridge, and treasurer, Walter H. Damon, of Springfield, both reelected; conductor, T. A. Hamson, of Hartford, Conn; doorkeeper Guy Squires, of Gardner, Mass.

The invitation of Salem, Mass., to hold the next convention in that city was accepted.

On Friday evening a concert was given in the drill room of the Armory, at which Joseph McKenna, of Jeulius Brothers, was the only outsider, the rest of the program being supplied by very creditable local talent. The meeting closed on Saturday with a picnic.

Lightning to Be Studied Again This Year

Going after the greatest menace of uninterrupted power transmission again this year, special Norinder cathoderay oscillographs will register lightning surges at five stations on four co-operating power company's transmission lines during 1929. These oscillographs, backed up by many scattered klydonographs for wholesale transient data, Osisos for locating the lightning stroke,



Latest type of Norinder oscillograph used in lightning study

and ingenious cameras for photographing the entire sky when lightning flashes, will let Westinghouse Electric & Manufacturing Company return from its campaign of lightning investigations at the end of the summer with accurate data on the behavior of lightning on transmission lines. The unique opportunity of studying artificial and natural lighting on the unenergized 220-kv. line of the Public Service Electric & Gas Company of New Jersey (the highest insulated line in America) with a portable lightning generator and a portable Norinder oscillograph will give facts—fresh from a line ready for service—never before available.

Satisfactory lightning investigation hinges on the combination Norinder-Du Four cathode-ray oscillograph shown in the photograph, a device which sketches the entire shock of lightning in terms of millions of volts and millionths of a second. A simple adjustment changes the cathode-ray oscillograph from a laboratory Du Four instrument into the Norinder type, which automatically sets itself off when lightning strikes.

Several power companies, realizing that lightning is a problem of the industry in general, are extending substantial help. They are the Public Service Electric & Gas Company, American Gas & Electric Company, Public Service Company of Northern Illinois and the Aluminum Company of America.

*Spot * News*

GOVERNOR ROOSEVELT, *of New York, has ordered an investigation of the new $500,000,000 merger by J. P. Morgan & Company of the Buffalo, Niagara & Eastern Power Corporation, the Mohawk Hudson Power Corporation and the Northeastern Power Corporation into the Niagara Hudson Power Corporation, to determine its effect on consumer rates. The combine brings under one management practically all upstate power interests in New York.*

* * *

LARGE SCALE PRODUCTION *of Diesel airplane motors is contemplated by the Packard Motor Car Company in a new manufacturing plant nearing completion in Detroit, Mich., as a result of the success of recent tests in which a Diesel-powered plane made a non-stop flight from Detroit to Langley Field, Va., in six hours and 50 minutes with a fuel cost of $4.68.*

* * *

THE STEADY INCREASE *in the use of power per capita in Canada is shown by a comparison of the figures for 1920 and 1927, recently issued. During this period the amount of power used per 100 of population increased from 43 to 63 hp., or the use of power per inhabitant increased over 46 per cent.*

* * *

STEAM IS USED, *in a recently developed German process, to eliminate static electricity from hides treated for leather manufacture. The steam ionizes the air in the leather finishing chambers, thereby providing a path for conducting away the charge in the hides.*

* * *

PRESIDENT HOOVER *has issued a proclamation declaring the Boulder Canyon Act of December 21, 1928, to be effective June 25, 1929. Construction of the dam will begin as soon as preliminary surveys are completed and contracts let.*

* * *

EXTENSION *of the industrial museum at Swatow, China, is now under way, and American firms interested in supplying models of modern industrial plants and machinery, are asked to communicate with the Bureau of Foreign and Domestic Commerce in Washington.*

* * *

THE SHED *in which the first electric light bulb was blown has been prepared for presentation to Henry Ford for his Edison museum at Dearborn by officials of the General Electric Company.*

* * *

AS A RESULT *of a movement started at the World Power Conference in 1926, an International Dam Construction Commission has recently been organized, the object of which is the study of all technical questions in connection with the construction of large dams. Twenty countries are represented so far with headquarters in Paris.*

A.S.R.E. Holds Spring Meeting at Penn State College

Members of the American Society of Refrigerating Engineers spent three crowded days at the annual mid-year meeting of the Society, which was held at Pennsylvania State College, June 20 to 22. Five technical sessions, involving 21 technical papers and professional addresses, an exhibition of refrigerating equipment, side trips and entertainments were the main features of a successful gathering. The business conducted centered around sessions on ice-plant design, refrigeration research and refrigerator merchandising, with two meetings devoted to problems of refrigerated transport.

Three papers on the design of ice plants were given at the opening session, Thursday morning. In the first of these, F. S. Strite, consulting engineer, of New York City, gave a comprehensive summary of the factors in the design of the building itself. The second paper, presented by C. T. Baker, consulting engineer of Atlanta, Ga., discussed the problem of following plant performance by the use of instruments now available. The last paper of this session was presented by George Lange, vice-president of the American Ice Company, New York City, who quoted extensive figures on oil engines as compiled by this company from records made in many of its plants. According to him the turning point in choosing an oil engine or an electric motor is at the place where current costs 1.2c. per kw.-hr.; while if it costs as high as 1.6c. up, the increased investment in an oil engine will pay a 50 per cent dividend in operating savings.

The brief session of the afternoon included a report in which several charts, showing temperatures prevailing in the various zones of the United States, was presented. This material, provided by the Weather Bureau, evoked much interest from those present. C. F. Belshaw, of the Geo. B. Bright Company, Detroit, discussed this matter and pointed out the fact that additional information involving wind velocities and minimum temperatures might be included in the data on weekly mean maximum temperatures and the humidities for the hottest week as covered in the charts made available to members at this session. This report was followed by an illuminating lecture on electrical measuring instruments as applied to refrigeration. This paper, covering a wide scope, was presented by C. Z. Rosecrans, head of electrochemical research, of the Leeds & Northrup Company, Philadelphia. Instruments of particular note are those giving automatic records of brine condition to aid in corrosion prevention in ice plants, and equipment to read relative humidities as low as 0.5 per cent.

Friday morning, June 21, was devoted to a discussion of the economics of freight-car refrigeration. This was

a joint meeting of the society with the Railroad Division of the American Society of Mechanical Engineers. The first paper, presented by the A.S.M.E., was a general introduction to the symposium by J. W. Roberts on the Pennsylvania Railroad. This paper was supplemented by a written discussion which gave many details of the operation of refrigerated transport—all illuminating to the refrigerating engineer. A collection of statistical information gathered by Mr. McPike, author of the second paper, led him to conclude that one ton of weight added to each refrigerator car increased the mere operating expense of hauling it by six million dollars a year, which figure ran larger than the entire claims paid by the railroad for food spoilage each year. On the basis of this he felt there could be no improvement in design if the increased cost had to be paid out of savings in the food. Lon A. Hawkins closed the meeting with an elaborate and scholarly discussion of the factors in food technology that relate to refrigerated transport.

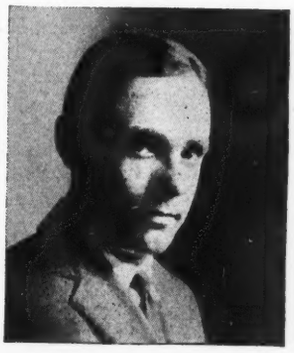
The meeting of the afternoon of this day went further into the railway refrigeration problem, discussing the actual cars and equipment. E. A. Sweeley gave a paper, presented on behalf of the A.S.M.E., treating in general terms the design of refrigerated cars. The discussion of this paper was extended to cover insulation, materials of construction, costs and design. The second paper presented, was printed in the June issue of *Refrigerating Engineering*. This paper covered extensive research on the refrigeration of transit by means of a master car, in which a complete refrigeration engine room is installed. R. W. Waterfill, of the Carrier Engineering Corporation, defended the engineering feasibility of this system against the criticism of practical railroad men, in a spirited manner. The closing paper was given by C. P. Goree, Atlanta, Ga., representative of the Frick Company. The paper covered the design of precooling fruit stations as used in the South and Northwest, going into the subject in a thoroughly technical manner, making available much new and valuable information.

Division of Engineering and Industrial Research Elects Officers

Officers, an executive committee, members at large and representatives of the engineering societies have been elected recently by members of the Division of Engineering and Industrial Research of the National Research Council. Serving for one year beginning July 1, the officers and executive committee are as follows: Chairman, Elmer A. Sperry; vice-chairmen, D. C. Jackson and D. S. Jacobus; committee, H. N. Davis, Allen Hazen, F. B. Jewett and John Johnston. Members at large elected for a three-year period are: H. N. Davis, E. E. Free, Alexander Klemin, Fred Lavis, G. O. Smith and D. L. Turner. Society representatives also elected for a three-year period are: A.I.M.&M.E., J. A. Matthews; A.I.E.E., F. W. Peek, Jr.; A.S.M.E., A. E. White; A.S.C.E., Allen Hazen; A.S.T.M., G. W. Thompson; and S.A.E., E. P. Warner.

Plans are under way for having an unusual meeting of the Division early in the fall at the time some of the foreign leaders of research will be in this country in connection with their trip to the World Engineering Congress to be held in Japan in October.

Men in the News



JOHN A. HAWKINS

has been appointed chief engineer of the Merchants Ice & Cold Storage Company, Los Angeles, Calif., in charge of all mechanical work. Formerly assistant chief engineer of the Pacific Fruit Company at North Platte, Neb., Mr. Hawkins in 1923 won the N.A.P.R.E. scholarship in refrigeration and attended Siebel Institute in Chicago in 1924. On completion of the course he was transferred to San Francisco, where he supervised the building of a large ice plant. Since that time he has handled technical work for ice plants in southern California.

Engineering Education Society Holds Meeting

The 37th annual meeting of the Society for the Promotion of Engineering Education was held at the Ohio State University, Columbus, Ohio, June 19-21. Dexter S. Kimball, president of the society, presided at the four business sessions, at which consideration was given to the relation of various engineering courses to work after graduation. A conference was held on the subject of the graduate and his work, at which representatives of industry and educational institutions gave their opinions. Addresses on vital topics of the day and many entertaining social activities rounded out the program.

News of Canada

Plans for Glace Bay Plant Completed—New Toronto Hotel Heated from Central Plant—McGill Inaugurates Fuel Course

By CAMPBELL BRADSHAW
Toronto, Canada

WITH plans completed for the erection of a $2,000,000 power plant at Glace Bay, N. S., to furnish steam for the Sydney mines and other units at Cape Breton of the British Empire Steel Corporation, one of the problems of the industry on which a majority of the industrial workers in the Maritimes are dependent for a livelihood, may be solved. In this connection it is interesting to recall the January, 1926, report of the Royal Commission on Nova Scotia's mining industry, which made it clear that among the things necessary to stabilize Nova Scotia's coal fields are: (1) Continuity of employment for the 12,000 to 14,000 men mining Besco's coal and (2) Steady operation of the mines to insure the efficiency impossible when operated but 202 to 263 days per man per year as at present.

With 50 per cent of the coal Besco now mines available by water to the St. Lawrence market, the competition of low-priced coal from West Virginia in Ontario and Quebec, consumers of 18½ million tons of coal a year or practically 60 per cent of Canada's total consumption, is food for thought, especially so when it is remembered that the domestic demands of the two provinces, around 4,000,000 tons a year, is almost entirely met by anthracite importations from the United States. Doubtless this is the main reason for the Royal Commission pointing out that a satisfactory coke for domestic use could be produced from the output of most of the mines in Nova Scotia to replace the West Virginia product, for which, in any event, a substitute will have to be found at an early date if the warning, given the Dominion in 1921 by the United States Bureau of Mines is heeded, that "with anthracite reserves in the United States exhausted in 1956, Canada will have to work out her own solution for replacing present importations of American anthracite." Therefore, it seems safe to assume that provision will be made in the new Besco plant for both a considerable increase in production and extensive equipment for the conversion of coal into coke, substantial increase in present output not only insuring stabilized employment, but improvement in the efficiency of all Besco operations.

Under the direction of Prof. Charles M. McKergow, with Prof. Leslie R. Thompson in charge of the classes, a course in fuel engineering is announced by McGill University at Montreal.

With boilers 40 ft. underground, ready for any emergency, the $16,000,000 Royal York Hotel, Toronto, largest

and finest structure of its kind in the British Empire, was opened for business on June 11, in the presence of more than 2,000 guests, by Viscount Willingdon, Governor-General of Canada, with E. W. Beatty, president, Canadian Pacific Railway, owners of the hotel, assisting. Heated by the plant of the Toronto Terminals Railway Company, of which Tom McAree is chief, the equipment of the Royal York is in the hands of A. W. Mason. The plant of the Terminals Railway Company, is, as far as central heating goes at least, an innovation in Canada, the steam generated not only furnishing heat for the Royal York, but for the Union Station and Post Office.

Washington Electric Plans New Power Project

The Washington Electric Company, of Seattle, has applied to the Federal Power Commission for a license covering a proposed development on the Columbia River. This application for license reaches the Commission before action has been taken on the application for preliminary permit. This indicates that the applicant has completed the engineering studies and is in a position to present the detailed figures for the consideration of the application for license.

The proposed project consists of two dams across the Columbia River at Rock Island 12 miles downstream from Wenatchee. One of the dams extends from the left bank to the island and the other from the right bank to the island. The power house will be an integral part of the left bank dam. The initial installation will be 80,000 hp., but provision will be made for the installation of an additional 120,000 hp. The pool will extend upstream 20 miles and will cover 3,030 acres. The power is to be sold to the Puget Sound Power & Light Company for public utility use.

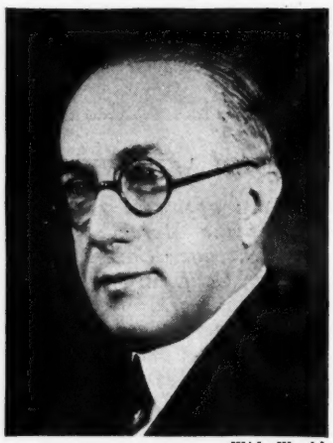
McGraw-Hill Announces "The Business Week"

Inaugurating a new type of service in gathering and interpreting business news, the McGraw-Hill Publishing Company announces that *The Magazine of Business* will be published weekly after Sept. 7, 1929, as *The Business Week*. The new magazine will be designed to serve in a unique capacity the need of the American business man for brief, carefully sifted news on every important development and trend of business. It will be manned by a staff of outstanding economists and specialists in the different fields of business interest. It will have a far-flung news-gathering organization supported by the editorial and reportorial resources of McGraw-Hill company.

Second only to its major function of news will be its interpretation of business conditions, which will be developed so as to forecast future business trends with accuracy and promptness.

F. A. Merrick Elected President of Westinghouse E. & M. Co.

F. A. Merrick, an executive well known within the electrical industry, was elected president of the Westinghouse Electric & Manufacturing Company by the board of directors of the company, meeting in New York, June 26. In announcing the election A. W. Robertson, chairman, also stated that the board of directors, while accepting the resignation of E. M. Herr, president



Wide World

F. A. Merrick, Westinghouse's New President

since 1911, in order that he might go on an extended vacation, had elected Mr. Herr vice-chairman.

Mr. Merrick advances into the position of president from the position of vice-president and general manager of the company. He is a native of New Jersey and received his technical education at Lehigh University. Shortly after his graduation, he was employed by the Steel Motors Company, a subsidiary of the Lorain Steel Company, where he was responsible for many important electrical inventions and where he held the position of manager and chief engineer. On the acquisition of the Steel Motors Company by the Westinghouse company, Mr. Merrick entered the Westinghouse organization. He was immediately selected to prepare plans for a plant in Canada and upon the formation of the Canadian Westinghouse Company, Ltd., in 1903 was made superintendent.

In the World War emergency, Mr. Merrick was assigned to organize the operations of the New England Westinghouse Company, located in Chicopee Falls, Mass., to manufacture rifles for the Russian government. When the United States entered the War, further demands were made upon the plant for American war material. Although required to reorganize and largely re-equip his factory to fulfill American war contracts, he completed an order for 60,000 Browning machine guns within eleven months after operations were begun. This manufacturing achievement has since generally been regarded in the industrial field as being without parallel.

After the War Mr. Merrick spent two years in London, England, as special representative of the Westinghouse Electric International Company, after which he returned to Canada to resume his duties as vice-president and general manager of the Canadian Westinghouse Company, Ltd.

The achievements of Mr. Merrick before, during and following the World War won for him in January, 1925, the position of vice-president and general manager of the Westinghouse Electric & Manufacturing Company, with headquarters in East Pittsburgh, Pa. In June, 1925, he was also elected a director of the company. Mr. Merrick will make his headquarters in Pittsburgh.

PERSONALS

F. L. BEERS, for the past thirteen years assistant editor of *Power*, retired on June 28. After 31 years of service in the Hill Publishing Company and the McGraw-Hill Publishing Company, Mr. Beers now expects to devote much of his time to travel. He carries with him the congratulations and best wishes of the entire staff of *Power*.

J. V. N. DORR recently sailed for a visit of three months in Europe. Part of his time will be devoted to the European interests of the Dorr Company.

ARTHUR C. WILLARD, immediate past-president of the American Society of Heating and Ventilating Engineers and professor of mechanical engineering at the University of Illinois, left on June 18 with Mrs. Willard to make a tour of the National Parks with the group representing the American Society of Mechanical Engineers.

DEXTER S. KIMBALL, dean of the College of Engineering of Cornell University, has been elected a member of the Board of Directors of the McGraw-Hill Publishing Company. Dean Kimball has long been a leader in the field of engineering education and an active contributor to the scientific and engineering press. He is a member of the American Society of Mechanical Engineers and the Society for the Promotion of Engineering Education. He is the author of several books on engineering subjects.

W. E. S. DYER, consulting engineer, of Philadelphia, who designed the 1,800-lb., high-pressure plant for the Philip Carey Manufacturing Company, Lockland, Ohio, has left for Europe to conduct the shop tests on some of the equipment which is awaiting shipment there. Construction of the plant will be started at an early date.

H. B. OATLEY, vice-president in charge of engineering of the Superheater Company, New York City, has left to make an investigation of railway conditions in Europe.

A. B. WEST, president and general manager of the Southern Sierras Power Company and subsidiaries, Riverside,

Calif., has been elected president of the Nevada-California Electric Corporation, the controlling company, with headquarters in Denver, Colo., succeeding E. S. Kassler, resigned.

E. J. SCHWANHAUSSER, assistant manager of the Harrison works, Worthington Pump & Machinery Corporation, recently sailed for Europe, where he will visit power plants in England, France and Germany.

A. A. HURST was recently re-elected president of the Eastern Iowa Power Company, Maquoketa, Iowa, at the annual directors' meeting.

BUSINESS NOTES

THE MANHATTAN RUBBER MANUFACTURING COMPANY, of Passaic, N. J., has announced, through its president, A. F. Townsend, its merger with the Raybestos Company, of Bridgeport, Conn., and the United States Asbestos Company, of Manheim, Pa. The Manhattan Rubber Manufacturing Company has long been a manufacturer of mechanical rubber goods, brake lining and clutch facings.

THE NEW YORK POWER & LIGHT CORPORATION has awarded the contract for the construction of its new hydroelectric station at Conklingville, N. Y., to Stevens & Wood, Inc.

THE GENERAL REFRACTORIES COMPANY, of Philadelphia, announces the removal of its Cleveland office to 1126 Leader Building, and of its Buffalo office to 1210 Genesee Building.

FOOTE BROTHERS GEAR & MACHINE COMPANY has appointed S. Howard Eisenberg its representative in Colorado, Wyoming and New Mexico, with headquarters at 2812 Ash St., Denver, Colo. This company recently announced the opening of a sales office at 1855 Industrial St., Los Angeles, Calif.

YEOMANS BROTHERS COMPANY, of Chicago, has appointed the Ryan Sales Company, 1122-24 Stahlman Building, Nashville, Tenn., to represent it in that state east of the Tennessee River.

CONSOLIDATED ASHCROFT HANCOCK COMPANY, INC., announces that its general sales office has been changed from New York to Bridgeport, Conn., effective July 1. G. A. Binz, has been named assistant to the vice-president in charge of industrial sales research; W. P. Bradbury appointed general sales manager, and N. B. Carlton Western sales manager, with headquarters in Chicago.

LINDE AIR PRODUCTS COMPANY'S new plant at Louisville, Ky., started producing oxygen on May 29, with R. Frye as superintendent.

Coming Conventions

American Institute of Electrical Engineers. Pacific Coast Regional Meeting, Santa Monica, Calif. Sept. 3-6. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Welding Society. Fall meeting at Cleveland, Ohio, Sept. 9-13. Secretary, M. M. Kelly, 33 West 39th St., New York City.

National Association of Power Engineers, 47th annual convention, Chattanooga, Tenn., Sept. 9-13. Fred Raven, secretary, 417 South Dearborn St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

Universal Craftsmen Council of Engineers. Annual meeting in Detroit, Mich., Aug. 6-10, at the Book-Cadillac Hotel. Grand Secretary, T. H. Jones, 33 Linden Ave., Cherrydale, Va.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

TRADE CATALOGS

TACHOMETERS—Catalog 1240, issued by James G. Biddle, 1211-13 Arch Street, Philadelphia, describes the Frahm vibrating-reed tachometer for use on steam turbines of from 800 to 12,000 r.p.m. This catalog is well illustrated, containing a number of views of installed tachometers.

COMPRESSORS — Four leaflets, numbered 1118 to 1121, issued by the General Electric Company, of Schenectady, N. Y., illustrate and describe single-stage and two-stage, stationary and portable reciprocating air compressors. Another leaflet, 1066A, presents centrifugal air compressors, of capacities ranging from 1,500 to 40,000 cu.ft. per min., for sewage-disposal systems.

PUMPS — A twelve-page illustrated bulletin issued by Yeomans Brothers Company, of Chicago, presents the features and specifications of Yeomans' heavy-duty bilge pumps and special pumps, space also being devoted to the extra equipment obtainable.

GEARS AND COUPLINGS — Catalog C-1831 gives pictured specifications and typical installations of single-reduction mill units; Circular 1838 is devoted to type E flexible couplings, with description, principal features and instructions for alignment. A twenty-page booklet, C-1579-F, illustrated, gives an account of the design, application, history and distinctive features of micarta gears. All these pamphlets have recently been announced by Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

AIR FILTERS — "Perfect Automatic Air Filtration" is claimed for the Reed Multi-Panel Air Filter, completely described in a booklet just issued by the Reed Air Filter Company, Inc., of Louisville, Ky. Special features, such as the exclusive "Bakelite-fibre" coating, and the continuous cleaning process, are described in detail. A table of the sizes and capacities of the various models is also indicated.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.35 @$2.40
Kanawha.....	Columbus.....	1.25 @ 1.50
Smokeless.....	Cincinnati.....	1.75 @ 2.00
Smokeless.....	Chicago.....	1.75 @ 2.25
S. E. Kentucky...	Chicago.....	1.35 @ 1.60
Steam.....	Pittsburgh.....	1.55 @ 1.65
Gas Slack.....	Pittsburgh.....	1.00 @ 1.15
Big Seam.....	Birmingham....	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.50@$2.75
Barley.....	New York.....	1.50

FUEL OIL

New York—June 27, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 5.25c. per gal.; 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—June 18, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.395 per bbl. or 42 gal.; 26@28 deg., $1.445 per bbl.; 28@30 deg., $1.495 per bbl.; 30@32 deg., $1.545 per bbl.; 32@36 deg., gas oil, 4.48c. per gal.; 38@40 deg., distillate, 5.23c.

Pittsburgh—June 18, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.5c. per gal.

Philadelphia—June 22, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—June 18, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—June 22, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 62.5c. per bbl.; 26@30 deg., 70c. per bbl.; 30@32 deg., 95c. per bbl.

Boston—June 24, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.45c. per gal.; 28@32 deg., 5.5c. per gal.

Dallas—June 22, f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Calistoga—City is having plans prepared for the construction of a sewage disposal plant including pumping system, etc. Estimated cost $13,000. G. A. Mitchell, is city engineer.

Calif., Sonora—Pacific Gas & Electric Co., 245 Market St., San Francisco, plans the construction of a multiple arch dam in Lyons Valley near here for power purposes. Estimated cost $200,000.

Fla., Hollywood—City, C. E. Burgon, Mgr., will receive bids until July 15 (extended date) for waterworks improvements including pumping station, etc. Former bids rejected.

Idaho, Lewiston—Idaho Power Co., 7th and Bannock Sts., Boise, will not construct hydroelectric power plant on Snake River near here. This corrects report in June 11 issue.

Ill., Chicago — J. T. Wheeler & Associates, 120 South La Salle St., will receive bids about July 1, for the construction of a 16 story apartment building including refrigeration system, etc. on Maple and La Salle Sts. Estimated cost $1,500,000. L. Gunzel, 879 North State St., is architect.

Ind., Bloomington—City is having plans prepared for the construction of a water and light plant. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, Mo., is engineer.

Ind., Fort Wayne—Lincoln Bank & Trust Co., will receive bids until July 5, for a 22 story bank and office building including steam heating system, elevators, etc. at Court and Barry Sts. Estimated cost $1,000,000. A. M. Strauss, 415 Cal-Wayne Bldg., is architect.

Ind., Michigan City—Northern Indiana Public Service Co., Hammond, awarded contract for the construction of an electric generating station here to Herlihy Bros., 228 North La Salle St., Chicago, Ill. Estimated cost $10,000,000.

Mass., Salem—Eastern Massachusetts Electric Co., 197 Washington St., plans the construction of a power plant. Estimated cost $100,000. Architect not selected.

Mich., Detroit—Dept. of Water Supply, D. C. Grobbel, Secy., 735 Randolph St., will receive bids until July 10, for the superstructure of a low lift pumping plant at Waterworks Park. G. H. Fenkell, 735 Randolph St., is engineer.

Mo., Eldorado Springs—City is having preliminary plans prepared for the construction of a power plant. Burns & McDonnell Engineering Co., 401 Interstate Bldg., Kansas City, Mo., is engineer.

Neb., South Sioux City—City plans the construction of two pumping stations in connection with sewage treatment work. Estimated cost $100,000.

N. J., Elizabeth—Elizabethtown Water Co., 64 Broad St., awarded contract for the construction of a pumping station and dam including boilers, oil burners, etc. to Keefe Construction Co., Inc., 270 Morris Ave. Estimated cost $25,000.

N. J., Hillsdale — Dept. of Institutes & Agencies, State Office Bldg., Trenton, is having plans prepared for the construction of a dormitory and power plant. Estimated cost $150,000. Guilbert & Betelle, 20 Branford Pl., Newark, are architects, also soon lets contract for a power plant including two 300 hp. boilers and other equipment at Greystone Park. C. N. Leatham, State Bldg., Trenton, is engineer.

N. J., Newark—Guilbert & Betelle, 20 Branford Pl., Archts., will receive bids about July 15 for the construction of a hospital, nurses home, power house, etc. at Newton and Williams Sts. for Newark Memorial Hospital, A. Goertz, Pres., 340 Bank St. Estimated cost $1,250,000.

N. J., Red Bank—Standard Oil Co. of New Jersey, 185 Washington St., Newark, awarded contract for the construction of pump house and works here to R. W. Clark & Co., Inc., 527 Bangs Ave., Asbury Park. Estimated cost $40,000.

N. Y., Brooklyn—Emil Pfizer Co., 81 Maiden Lane, New York, awarded contract for addition to boiler plant on Gerry St., to Barney Ahlers Construction Co., 110 West 40th St., New York. Estimated cost $150,000.

O., Apple Creek — Dept. of Welfare, H. H. Griswald, Dir., Ninth and Oak Sts., Columbus, will receive bids until July 18, for the construction of a group of buildings including power house, two 400 hp. boilers, mechanical stokers, one 160 and one 240 kvw. generators, etc. at Institutions for Feeble Minded here.

O., Cleveland—Shaker Co., c/o C. L. Bradley, Terminal Tower, will soon award contract for a 3 story apartment building including steam heating, ventilation and refrigeration systems, boilers, elevators, etc. on Shaker Sq. Estimated cost $600,000. P. Lindsley Small & Associates, Terminal Tower, are architects.

Ore., Baker—City Council has authorized the mayor to employ an engineer to make surveys of the watershed to get power for a municipal light and power plant.

Pa., Glen Willard—U. S. District Engineers, Keenan Bldg., Pittsburgh, awarded contract for the construction of a group of lock buildings including 16 x 56 ft. riverwall power house, 15 x 56 ft. landwall power house, one 18 and two 23 in. turbines, etc. at Deadman's Island Locks on Ohio River to Van Arlen Construction Co. Stock Exchange Bldg., Philadelphia. Estimated cost $34,000.

Pa., Pittsburgh—Allegheny General Hospital, H. L. Mason, Oliver Bldg., awarded contract for the construction of a 15 story hospital including power plant at North Ave. and Porterfield St. to J. L. Stewart & Co., 17 East 42nd St., New York. Estimated cost $6,000,000.

Pa., Schuylkill Haven—Borough of Schuylkill Haven, will receive bids until July 8 for the construction of a 1 and 2 story, 38 x 102 and 48 x 63 ft. power plant. A. C. Wood, Stock Exchange Bldg., Philadelphia, is engineer.

Tex., Corpus Christi—H C. Wagner and L. B. Mead, 1515 Water St., plan the construction of a 20 ton ice and cold storage plant. Private plans.

Tex., San Antonio—Scobey Cold Storage Co., 315 North Medina St., is having plans prepared for the construction of a cold storage plant. Estimated cost $500,000. Private plans.

Tex., San Perlita—J. B. Curry, Raymondville, will build a 20 ton ice plant here. Estimated cost $25,000. Private plans. Work will be done by owner's forces.

Wash., Bremerton—City plans an election to vote $840,000 bonds for extensions and improvement to municipal lighting and water systems.

Wash., Vancouver—Empire Power & Light Co., G. W. Talbot, Pres., Portland, Ore., has been granted permit to construct two power plants on the north fork of the Lewis River near here. Estimated cost approximately $12,500,000.

Ont., Hailwybury—Sisters de la Misericorde, Montreal, Que., is having plans prepared for the construction of a 4 story hospital including power units, etc. on Main St. here. Viau & Venne, 59 St. James St., Montreal, Que., are architects.

Equipment Wanted

Boiler, Stoker, etc.—City of Springfield, Ill., will receive bids until July 15, for furnishing and installing a boiler with either under feed or chain stoker, economizer, air preheater, superheater, etc. for proposed improvements to power plant.

Engine, Regulator, Transformer, Etc.—State Building Commission, W. C. Trotter, Secy. of Bldg., Committee, Jackson, Miss., will receive bids until July 11 for 25 hp. Diesel engine, 22½ kva. volt regulator, 22½ kva. transformer, electric meters, etc. for University of Mississippi, Oxford.

Engine and Generator—City of Duncan, Okla., is in the market for a 300 hp. Diesel engine and generator with exciter and cooling equipment.

Engines—City of Chisholm, Minn., will receive bids until July 8 for furnishing and installing two Diesel engines. Estimated cost $80,000.

Meters and Pumping Equipment — City of Perth Amboy, N. J., P. P. Costello, clk., plans the installation of meters and pumping equipment. $10,000.

Motors—P.O. Box 254, Station A, Boston, Mass., is in the market for a.c. motors, 16 to 20 hp. capacity.

Pump—Bd. of Control, Dover, O., plans the installation of a 750 g.p.m. pump at auxiliary Park station. $20,000.

Pump, Motor, Etc.—City of Delano, Calif., S. G. Ladd, Clk, will receive bids until July 8 for furnishing and installing a deep well turbine pump, motor and other electrical equipment for proposed waterworks.

Pump, Motor, Engine, Etc.—R. M. Selkirk, Clk, Leamington, Ont., will receive bids until July 7 for 1000 g.p.m. three stage centrifugal pump equipped with electric motor and gasoline engine for proposed waterworks improvements.

Pumping Equipment, Etc.—Water Commissioners, Town Hall, Watertown, Mass., is receiving bids for pumping equipment, etc. for proposed waterworks.

Industrial Projects

Calif., Los Angeles—AUTOMOBILE BODY PLANT—Standard Auto Body Works, 1501 South Central Ave., will build a 1 story, 100 x 140 ft. factory at 15th and Paloma Sts. Work will be done by day labor.

Conn., East Hartford (br. Hartford)—AIRPLANE FACTORY—Pratt & Whitney Aircraft Co., 450 Capital Ave., Hartford, is having plans prepared for the construction of an airplane factory here. Estimated cost $500,000. A. Kahn, Inc., 1004 Marquette Bldg., Detroit, Mich., Archt.

Ind., Hammond — CHEMICAL PLANT — Stauffer Chemical Co., plans the construction of first unit of plant for the manufacture of sulphuric acid. Estimated cost $1,000,000.

Mich., Detroit—FACTORY—National Automatic Fibres Inc., 2106 East Lafayette Ave., is having plans prepared for the construction of a 1 story, 160 x 425 ft. factory on State Fair Ave. I. M. Lewis, 503 Congress Bldg., is architect.

Mo., North Kansas City—FACTORY—Mid-Continent Tank Car Co., 10th and Cherry Sts., plans addition to factory. Estimated cost $50,000. Private plans. Equipment will be required.

N. J., Perth Amboy—TILE PLANT ADDITION—Larson & Fox, 175 Smith St., Archts. and Engrs., are receiving bids for a 1 story, 60 x 115 ft. addition to tile plant, for C. Pardee Works, Smith St. Estimated cost $40,000.

N. J., Perth Amboy—CABLE MANUFACTURING PLANT — Standard Underground Cable Co., 26 Washington St., awarded contract for a 3 story plant at Old Perth Amboy dock site to Public Service Production Co., 80 Park Pl., Newark. Estimated cost $200,000.

N. Y., New York—FACTORY—Art Steel Co., 401 East 23rd St., manufacturers of steel filing cabinets and office furniture, plans the construction of a factory at College Ave. and 145th St. Estimated cost $250,000. Architect not selected.

Okla., Oklahoma City—COMPRESSED GAS PLANT—Prest-O-Lite Co., 30 East 42nd St., New York, N. Y., is having plans prepared for the construction of a 60 x 131 ft. plant here. Estimated cost $125,000. H. J. Tatnell, New York, N. Y., is engineer.

Pa., Minersville—TEXTILE PLANT—H. D. Bob Co., 40 Leonard St., New York, N. Y., is receiving bids for the construction of a plant at Lewis St. and Delaware Ave. here. Estimated cost $170,000. W. D. Shollenberger, 11 West 4th St., Williamsport, Pa., is architect.

S. C., Rock Hill—BLEACHERY—Rock Hill Printing & Finishing Co., awarded contract for the construction of a bleachery to Brown-Harry Construction Co., Gastonia, N. C. Estimated cost $400,000.

Tenn., Columbia — KNITTING MILL and BOILER HOUSE—Cadet Knitting Mills, Second and Allegheny Ave., Philadelphia, awarded contract for the construction of a 1 and 2 story, 107 x 343 ft. mill and 25 x 31 ft. boiler house, to T. C. Thompson & Bro., Charlotte, N. C.

Ont., Merritton — WHEEL AND FORGING FACTORY—Hayes Wheel & Forgings Co., W. Kisler, Mgr., Merritton, Ont., awarded contract for a 2 story, 85 x 100 ft. addition to factory on Thorold Rd., to E. P. Muntz, Temple Bldg., Toronto. Estimated cost $100,000. Equipment for forging automobile wheels and parts will be installed.

Ont., Toronto — FACTORY and BOILER PLANT — C. A. Dunham Co. Ltd., 229 College St., manufacturers of heating specialties, is having plans prepared for the construction of a 3 story, 40 x 50 ft. factory and 40 x 50 ft. boiler plant. Estimated cost $75,000. Private plans.

Ont., Toronto — BRASS MANUFACTURING FACTORY—James Morrison Brass Mfg. Co., 93 Adelaide St. W., is having plans prepared for the construction of a 4 story addition to factory for the manufacture of heating and plumbing supplies. Estimated cost $150,000. Catto & Catto, 1 Wellington St. E., are architects.

Ont., Walkerville—MOTOR FACTORY—Chrysler Corp. of Canada, plans the construction of a 5 story, 100 x 180 ft. addition to motor factory. Estimated cost $500,000. Hutton & Sauter, 6 James St., S., Hamilton, are architects.

Que., Hull—FOUNDRY—Hull Iron & Steel Foundries Ltd., Montcalm St., plans the construction of a 4 story, 90 x 300 ft. foundry. Estimated cost $200,000. Electrically operated heat treating steel ovens to produce high-grade alloy steel will be installed.